SEPTEMBER
1919
20cts.

ELECTRICAL EXPERIMENTER

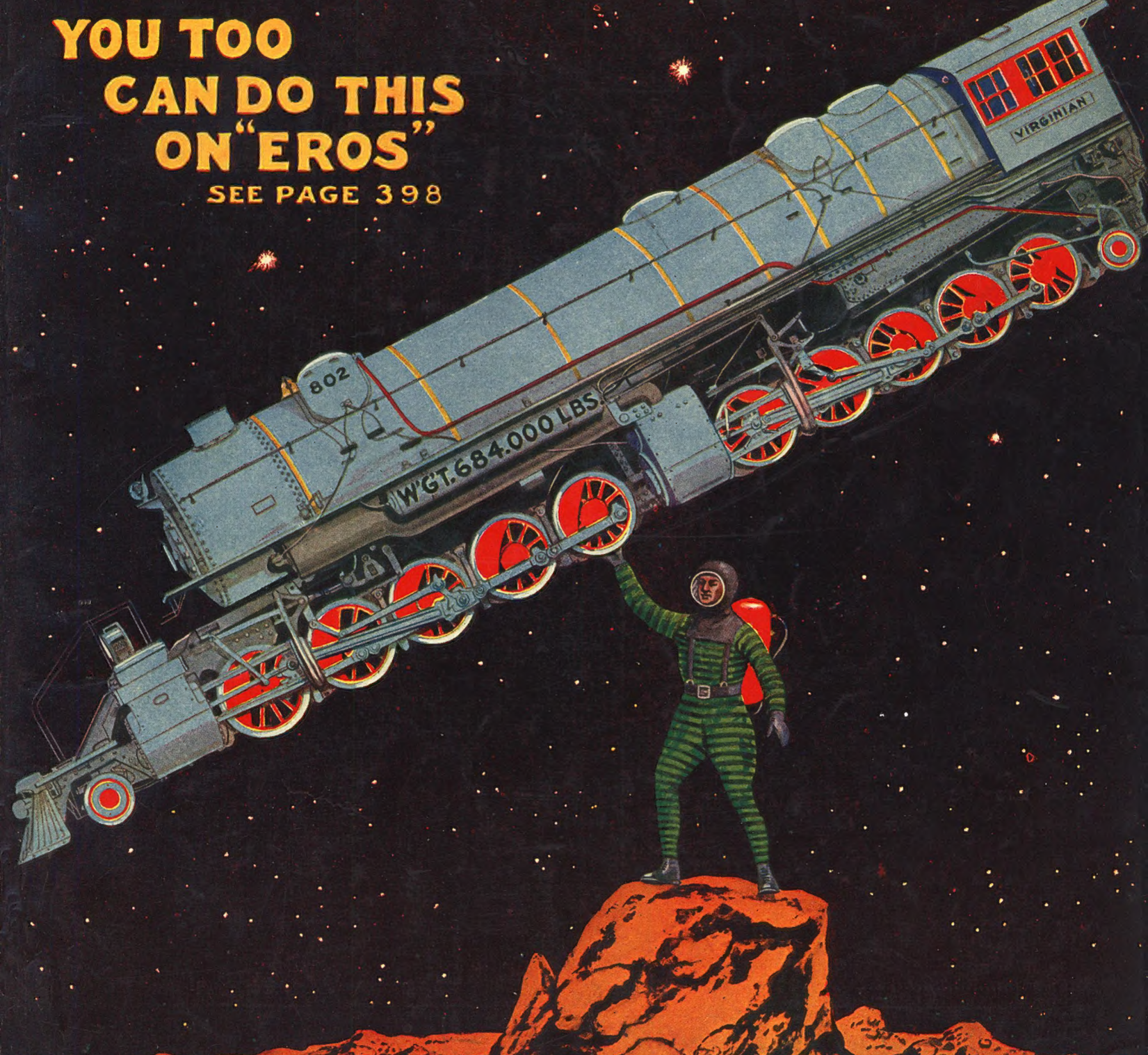
OVER
175
ILLUST.

SCIENCE AND INVENTION

REG. U.S. PAT. OFF.

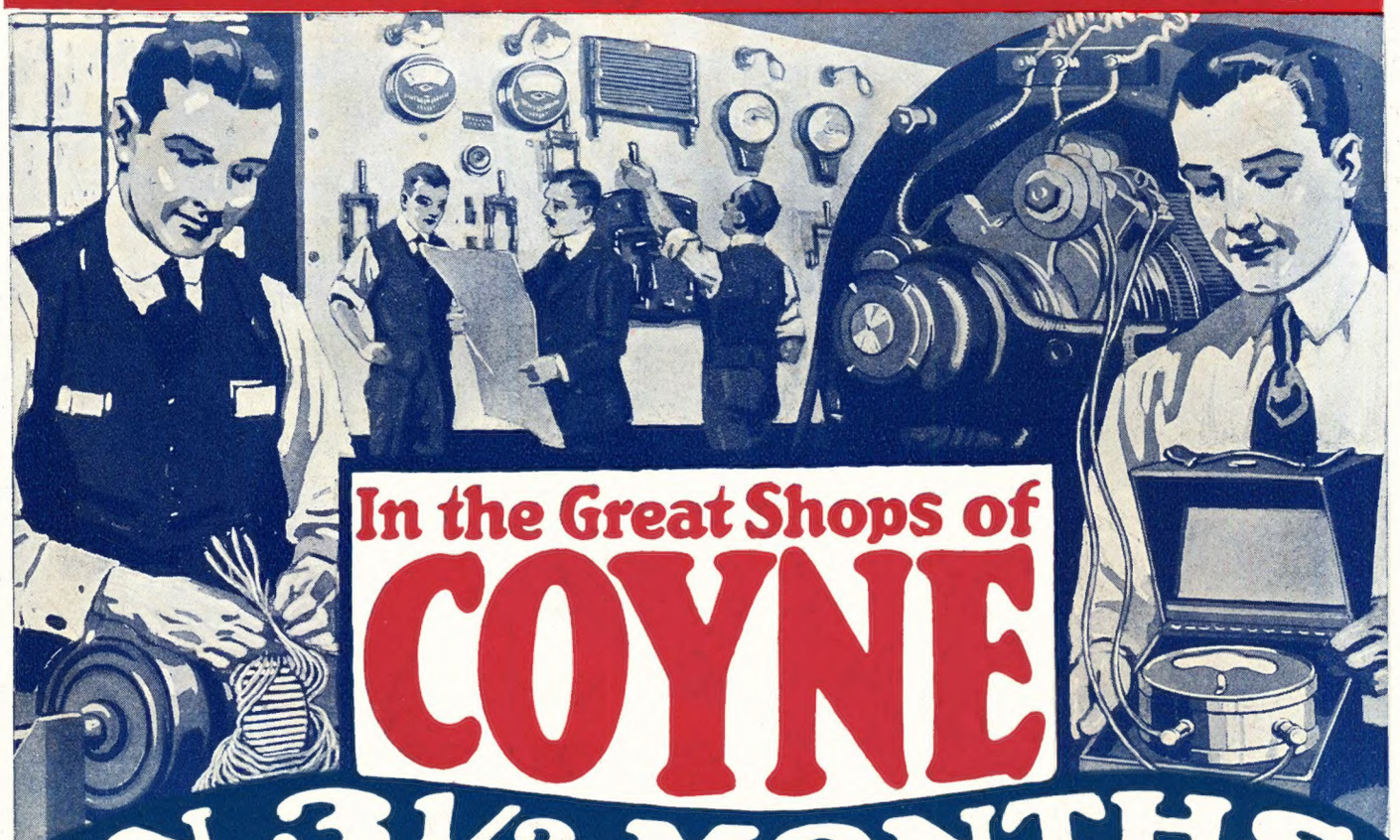
YOU TOO CAN DO THIS ON "EROS"

SEE PAGE 398



"OVER 125,000 COPIES MONTHLY—LARGEST CIRCULATION OF ANY ELECTRICAL PUBLICATION"

Learn Electricity



In the Great Shops of COYNE

IN 3½ MONTHS

Thousands of Electrical experts are needed to help rebuild the world. Come to Chicago to the great shops of Coyne and let us train you quickly by our sure, practical way, backed by twenty years of success. Hundreds of our graduates have become experts in less than four months. *You* can do the same. *Now* is your big opportunity. Come—no previous education necessary.

Earn $125 to $300 a Month

In the Electrical business. Come here where you will be trained in these great $100,000 shops. Experts show you everything and you learn right on the actual apparatus. You work on everything from the simple bell to the mighty motors, generators, electric locomotives, dynamos, switchboards, power plants, everything to make you a master electrician. We have thousands of successful graduates. Just as soon as you have finished we assist you to a good position.

Become An Expert in 3½ Months

No need of taking from 1 to 4 years to become an expert, we have proved this in thousands of cases. The Coyne method of practical training eliminates all books, useless theory and other non-essentials and trains you in just what you need to know to become an expert.

Earn Your Way

Dozens of our students every year work in their spare time and earn their living expenses. Dozens of others work in the day time, earn all their expense and attend our evening school. Our employment department will help you without charge.

Send Today for Big Free Book

Write today, *now*, for the book. It tells what Coyne graduates have done. What you can do. Fill in the coupon, check the trade you are most interested in or send a postal card, do it *now*.

Simplest Instruction Known

You need have no previous experience before coming here, for we start you on the simplest things. Experts stand beside you to guide and instruct you while you do the actual work with your own hands just exactly as you will later do it with your diploma as Master Electrician. You learn everything so you can handle the big jobs that are offered to Coyne graduates.

LEARN DRAFTING

Practical instruction in large drafting rooms in big shops with experts standing beside you. Learn Mechanical Drafting and Machine Design, including Automobile Design, with actual machinery around you. Take Builders' Course or Architectural Drafting with Bricklaying students actually carrying out your plans. Coyne graduates in demand. We place graduates in good positions.

Motion Picture Operating

During the past eleven years we have trained hundreds of men for positions as Chief Operators at $25 to $50 per week through practical instruction by experts in modern Projection Rooms with all types of machines. Complete course, taught thoroughly yet quickly, at small cost.

DAY OR EVENING COURSES

Don't worry about the money. Anyone with ambition can learn here. Our tuition is low with small easy payments if desired. All tools and equipment is furnished free. Our students live in comfortable homes in the best section in Chicago—on the lake—just a few minutes' walk from our school.

COYNE TRADE AND ENGINEERING SCHOOLS
Bennett W. Cooke, President
Dept. 29, 39-51 E. Illinois St., Chicago, Ill.

Please send at once your big Free Book—I am interested in

[ ] Electricity [ ] Drafting
[ ] Motion Picture Operating
(Check trade interested in)

Name.....

Address.....

BENNETT W. COOKE, *President*
COYNE TRADE AND ENGINEERING SCHOOLS
Dept. 29 39-51 E. Illinois Street, Chicago, Ill.

MAIL COUPON FOR FREE BOOK NOW

A Direct Route to BIGGER PAY

NO MONEY DOWN

SMALL MONTHLY PAYMENTS

THROUGH ELECTRICITY you can earn more. The salary of the electrical worker is steadily advancing. Especially is this true of those who are educating themselves in the finer points of electrical practice.

Fit yourself for one of the really big jobs by knowing electrical practice complete, including inside and outside work, central stations, and the whole subject. It takes long years to do this in practice only, whereas, with the aid of the CROFT LIBRARY OF PRACTICAL ELECTRICITY it takes only months.

No matter how much nor how little you know of electricity, the Croft Library will be found of assistance every day. You will immediately recognize the fact that the author is a practical man. You will immediately see the great difference between these and other books on the subject you possess.

READ THIS—

McGraw-Hill Book Company, Inc.,
239 West 39th Street, New York, N. Y.

Gentlemen: In an attempt to express myself about CROFT'S NEW LIBRARY OF PRACTICAL ELECTRICITY, I have never seen and do not believe there was ever printed in the English language, a more comprehensive set of books. It is a library that is just as valuable to the novice as to the expert, because it is all practice.

Respectfully,

GUY H. PEIFER,
Chief, Doplan Silk Corporation, Hazelton, Pa.

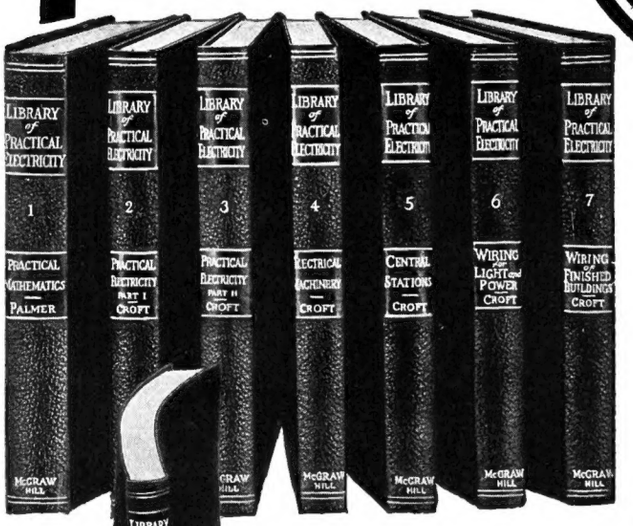
ELECTRICAL PRACTICE COMPLETE

AND THIS—

McGraw-Hill Book Co., Inc.,
239 W. 39th St.,
New York.

Gentlemen: The CROFT LIBRARY OF ELECTRICITY more than came up to my expectations. I have been in the electrical business for fifteen years, and know the general run of electrical books. Terrell Croft's Library is the best I have had the pleasure of examining.

Yours truly,
EDWARD T. HOFF,
713 3rd Ave.,
Asbury Park, N. J.



The Croft Library adheres closer to actual practice than anything of the kind ever attempted. It is the most complete set of books on electricity ever published. It is clearest in word and illustration. It has no equal in every-day helpfulness. It cannot be compared in any way with other sets of books on this subject.

Just return the coupon—

Fill out the coupon below and return to us. We will immediately send the eight volumes, charges prepaid, for ten days' use in connection with your work. Don't bother to send any money. We do not want a cent from you until you have examined the books and decided that they are a direct route to bigger pay. Then you can send us $2 per month for eight months.

McGraw-Hill Book Co., Inc.
239 West 39th St., New York

MAIL THIS COUPON TO-DAY

AND THIS--

Electricity, from the simplest principles to complete and economical operation of a central station.

Motors, generators, armatures, commutators, transformers, circuits, currents, switchboards, distribution systems.

Electrical machinery of every type; installation, operation and repair.

Wiring for light and power. How to do it mechanically perfect, in accordance with the National Electrical Code.

Wiring of finished buildings, Underwriters' and municipal requirements. How to do the complete job from estimating it, to completion.

Illumination in its every phase. The latest and most improved methods of lighting. Lamps and lighting effects.

A complete course in mathematics as applied to work. A course which refreshes your mind, and gives you mastery of all the shortcuts in figuring.

Electrical practice complete. Electrical practice as experts know it. Electrical practice by experts.

McGraw-Hill Book Co., 239 W. 39th St., New York

Gentlemen:—Please send me the Library of Practical Electricity (shipping charges prepaid), for 10 days' free examination. If satisfactory, I will send $2 in ten days and $2 per month until $16 has been paid. If not wanted, I will write you for return shipping instructions.

Name .....

Home Address .....

City and State .....

Where Employed .....

Occupation Ex9-19

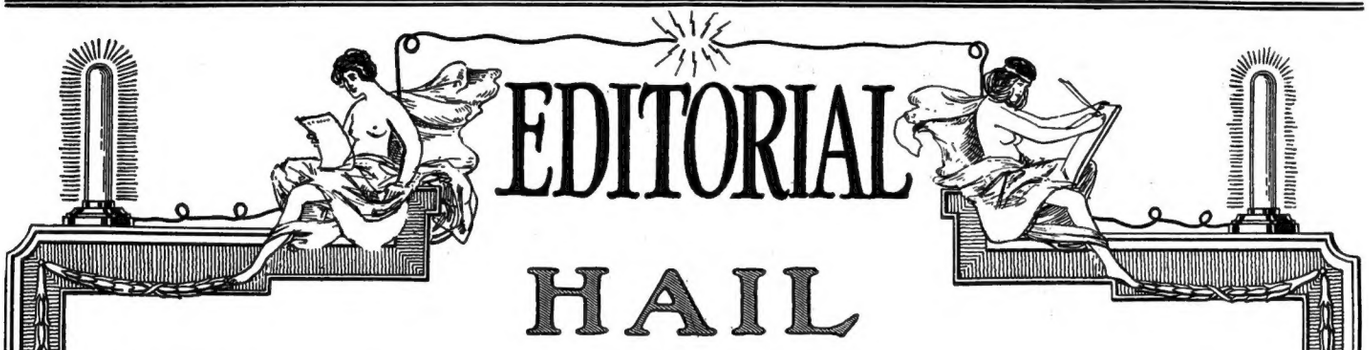
Electrical Experimenter

233 FULTON STREET, NEW YORK

Publisht by Experimenter Publishing Company, Inc. (H. Gernsback, President; S. Gernsback, Treasurer; R. W. DeMott, Sec'y;) 233 Fulton Street, New York.

Vol. VII. Whole No. 77 **Contents for SEPTEMBER, 1919** **No. 5**

YOU TOO CAN DO THIS ON "EROS".....Front Cover
From a painting by George Wall
SILHOUETTE MOVIES, By H. Gumpel..... 395
AN ELECTRIC SIGN IN MID-AIR..... 396
SPEEDING UP THE AIRSHIP, by H. Gernsback..... 397
POPULAR ASTRONOMY — INTERESTING PHENOMENA OF GRAVITATION..... 398
By Isabel M. Lewis of the U. S. Naval Observatory.
WORLD'S BIGGEST TURBINE DYNAMO—100,000 HORSEPOWER 401
By William H. Easton.
HOW THE R-34 CROST THE ATLANTIC..... 402
UNDER-WATER SURVEYING BY REFLECTED SOUND WAVES. 405
By H. Winfield Secor, Associate Member of A. I. E. E.
A TELLTALE SUBMARINE NET..... 406
ELECTROCUTING HUGE LEOPARD..... 406
PSYCHICAL RESEARCHES OF SIR WILLIAM CROOKES..... 407
By Hereward Carrington, Ph. D.
TELEPHONE SOLVES "LOWER BERTH" SQUABBLE..... 408
200,000 HORSEPOWER IN ONE HOUR, by Joseph H. Kraus..... 409
POSSIBILITIES OF HIGH FREQUENCY CURRENTS..... 410
By John E. Pritchard.
A NEW PHOTO-ELECTRIC CELL TO REPLACE SELENIUM..... 411
ELECTRIC COOKERY—A SNAP!..... 412
By Grace T. Hadley of the Society for Electrical Development.
NEW THINGS ELECTRICAL..... 413
RECORDING YOUR CHAUFFEUR'S JOY RIDES, by Thomas Reed 414
TRY THESE ON YOUR AUTO..... 415
THE MYSTERY OF ATMOSPHERIC ELECTRICITY..... 416
By Rogers D. Rusk, M.A.
EXPERIMENTS IN PHYSICS—NO. 2, ILLUSIONS..... 417
By John J. Furia, A.M.
PRACTICAL CHEMICAL EXPERIMENTS—PART 2—CLEANING AND WASHING AGENTS, by Albert W. Wilsdon..... 418
THE CONSTRUCTOR—THERMO-ELECTRICITY EXPERIMENTS. 419
By Thomas W. Benson.
MAKING A MACHINE FOR TELEGRAPHING PICTURES..... 421
By Leroy J. Leishman, Telephotographic Expert.
HOME-MADE COMPOUND MICROSCOPE, by Carl F. Muckenhoupt 422
EXPERIMENTAL MECHANICS—MACHINE SHOP PRACTISE, THE REAMER, Continued, by Samuel D. Cohen..... 423
"HOW TO MAKE IT" PRIZE CONTEST..... 424
WRINKLES, FORMULAS AND RECIPES, Edited by S. Gernsback.. 425
RADIO DEPARTMENT—"FOG WARNING" RADIO TELEPHONE 426
NEW 1 K.W. QUENCHED GAP TRANSMITTER, by Lester F. Ryan 427
VACUUM VALVE CONSTRUCTION, by R. H. Shaw..... 429
THE HOW AND WHY OF RADIO APPARATUS—NO. 12, RADIO ANTENNA CONSTRUCTION, by H. Winfield Secor..... 430
ECCENTRIC ANTENNAE, by Eugene Dynner..... 432
LATEST PATENTS DIGEST..... 433
AMATEUR LABORATORY PHOTO CONTEST..... 434
SCIENCE IN SLANG—THE ALTERING OF ALTERNATING CURRENT, by Emerson Easterling..... 435
THE ORACLE—QUESTION AND ANSWER COLUMN..... 436
DEVELOPING AN IDEA, by Nelson Hall..... 455



EDITORIAL

HAIL

EVERY year millions of dollars' worth of crops and property are destroyed by hailstorms. Not infrequently human beings and cattle are killed, due to their inability to reach shelter in time. Of course such occurrences are not very frequent, which is explained by the fact that the average size of a hailstone is not much larger than a small hazelnut. But hailstones the size of a man's fist are by no means uncommon. Stones weighing two pounds have been observed, but these are very rare. But whatever their size or weight, hailstones are exceedingly destructive. Hurled from a great height, with a powerful wind accelerating their own speed, these frozen ice-pellets destroy vegetation at an appalling rate annually. Fruit on trees, crops and all vegetables are mowed down over great areas several times each year.

In the United States there is an average of over three hailstorms a year—Ohio leading with over ten such storms annually. Now the curious and outstanding fact about hailstorms is that nearly all of them occur during the summer, and practically none occur without thunder and lightning. There is nothing new contained in this statement—every child knows it. But here the writer would like to inject a new thought: namely, that the formation of hailstones is directly due to certain and as yet not clearly understood electrical processes. In other words, the formation of these round ice stones is the product of the electric current or static electricity.

This theory can be upheld by a few very simple arguments. In the first place, the height at which hail-clouds move is very low—never high enough to permit water to freeze. Proof: During all hailstorms rain always falls amid the hailstones, *and this rain is quite warm.* If the hail were formed by a sudden cold air wave, as our text-books want us to believe, where do the warm raindrops come from—or why does it not snow at least? However, it never does, particularly during the summer season.

But this is not all of the story. According to Jaentr, who investigated the subject thoroly, each hailstone is, as a rule, composed of a mass of mixed snow and ice in whose interstices there is held a gas—probably air or oxygen—powerfully comprest within the central cavity. If the hailstone is opened under water, the enclosed gas is seen to expand. According to Jaentr this gas is held under a pressure of as high as *fifty atmospheres!* We know that cold alone cannot produce such a result, but we do know that the electrical current under certain favorable circumstances can and does produce cold. However, we admit that our present knowledge is not sufficient to permit of a clear understanding of the complicated processes that take place in the formation of a hailstone. It should be a fruitful field for the investigator.

This brings us to a remedy for hailstorms. Many methods have been tried in the past to prevent these destructive storms—notably cannonading the clouds in France, Austria and Italy. No relief whatsoever was had.

But if we once admit the electrical nature of hailstorms and fully prove it, the remedy should be simple. Huge kites, larger than those built up to now and capable of carrying a thick, stranded copper cable, should be sent aloft immediately when storm clouds gather. At a ridiculously low cost a dozen such kites, spaced a mile apart, could draw the electrical charge to earth, thus emptying the clouds of their danger. It is worth a trial at least.

H. GERNSBACK.

The **ELECTRICAL EXPERIMENTER** is publisht on the 15th of each month at 233 Fulton Street, New York. There are 12 numbers per year. Subscription price is $2.00 a year in U. S. and possessions, Canada and foreign countries, $2.50 a year. U. S. coin as well as U. S. stamps accepted (no foreign coins or stamps). Single copies, 20 cents each. A sample copy will be sent gratis on request. Checks and money orders should be drawn to order of EXPERIMENTER PUBLISHING CO., INC. If you change your address notify us promptly, in order that copies are not miscarried or lost. **A green wrapper indicates expiration. No copies sent after expiration.**

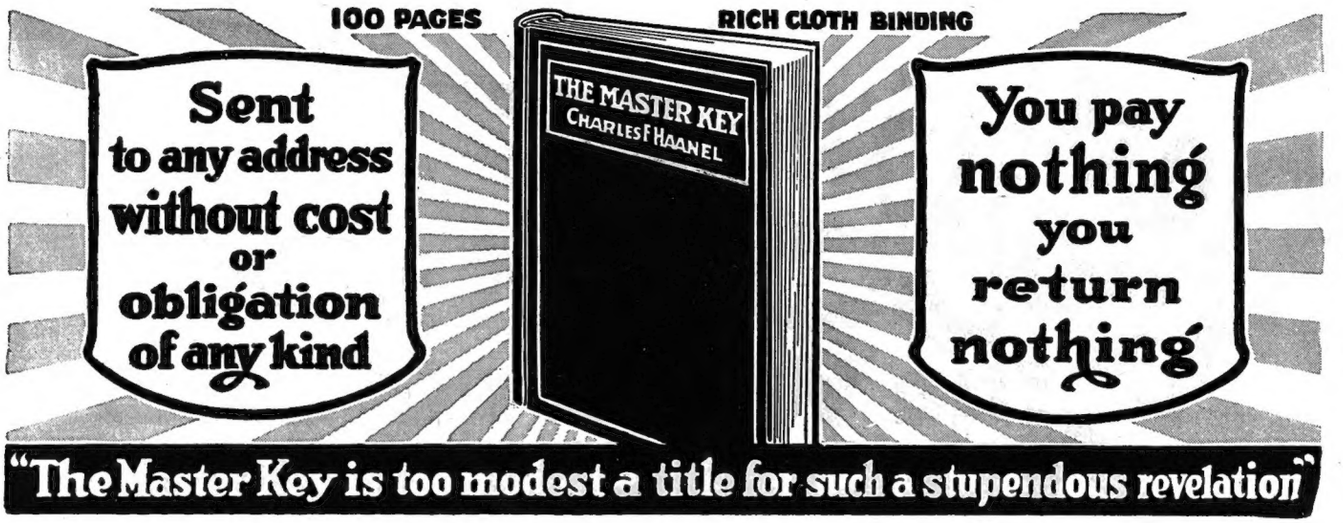
All communications and contributions to this journal should be address to: Editor, ELECTRICAL EXPERIMENTER, 233 Fulton Street, New York. Unaccepted contributions cannot be returned unless full postage has been included. ALL accepted contributions are paid for on publication. A special rate is paid for novel experiments; good photographs accompanying them are highly desirable.

ELECTRICAL EXPERIMENTER. Monthly. Entered as second-class matter at the New York Post Office under Act of Congress of March 3, 1879. Title registered U. S. Patent Office.

Copyright, 1919, by E. P. Co., Inc., New York. **The Contents of this magazine are copyrighted and must not be reproduced without giving full credit to the publication.**

The ELECTRICAL EXPERIMENTER is for sale at all newsstands in the United States and Canada; also at Brentano's, 37 Avenue de l'Opera, Paris.

Member of the Audit Bureau of Circulation.


100 PAGES
RICH CLOTH BINDING
Sent to any address without cost or obligation of any kind
THE MASTER KEY
CHARLES F HAANEL
You pay nothing you return nothing
"The Master Key is too modest a title for such a stupendous revelation"

SOME men and women seem to attract success, power, wealth, health and attainment with very little conscious effort; others conquer with great difficulty, still others fail altogether to reach their ambitions, desires and ideals.

Why is this so?

"The Master Key" will tell you why. No one can read it and not be a changed man or woman. None but who will emerge from its magic pages with a firmer grasp of the future—a surer understanding of what he can do.

"The Master Key" is a key with which many are converting loss into gain, fear into courage, despair into joy, hope into fruition.

A copy of this magnificent, richly bound 128 page book will be sent to you, without cost or obligation of any kind, if you address

Charles F. Haanel, 423 Granite Bldg., St. Louis, Mo.

You should send for a Master Key.

New Way to Learn

The World's Greatest ELECTRICAL BOOKS

IT'S no longer necessary to serve an apprenticeship or go to school to learn electricity. With this new library of PRACTICAL APPLIED ELECTRICITY you learn right at home—in your spare time without interfering with your present work. You can pick out any good, paying job that requires a trained man and fit yourself to fill it in a very short time by spending an hour or two a day with these books. There's no tiresome lessons and a lot of higher mathematics for you to wade through. No theory and historical data that you will never use. Nothing but plain English and common everyday figures anybody can understand. It's a home study course for the beginner and a handy reference guide for the expert combined.

Here Is What You Learn

Here are 100 different subjects selected at random from the eight big volumes. This is just a small part of the total number of things explained. Several thousand propositions are treated.

VOLUME I. **Elements of Electricity:** Magnetism—Static Electricity—Current Electricity—Battery Circuits—Electromagnets—Principles of Dynamos and Motors—Induction Coils—Telephone Principles. **Principles of D. C. Dynamos:** Field Magnets—Armatures—Voltage Regulation. **Principles of D. C. Motors:** Comparison with Generator—Operation—Design. **Storage Batteries:** Maintenance—Commercial Applications.

VOLUME II. **Alternating Current Machinery:** Instruments—Armature Windings—Regulation—Output—Tests—Commercial Types—A. C. to D. C. Current—Converters—Switchboards—Synchronizers.

VOLUME III. **D. C. Dynamo Design:** Efficiency—General Principles. **Armature Winding:** Calculations. **Design of Small Motors:** D. C. Design—A. C. Design—Induction Motor Design. **Transformers:** Operation—Efficiency—Construction.

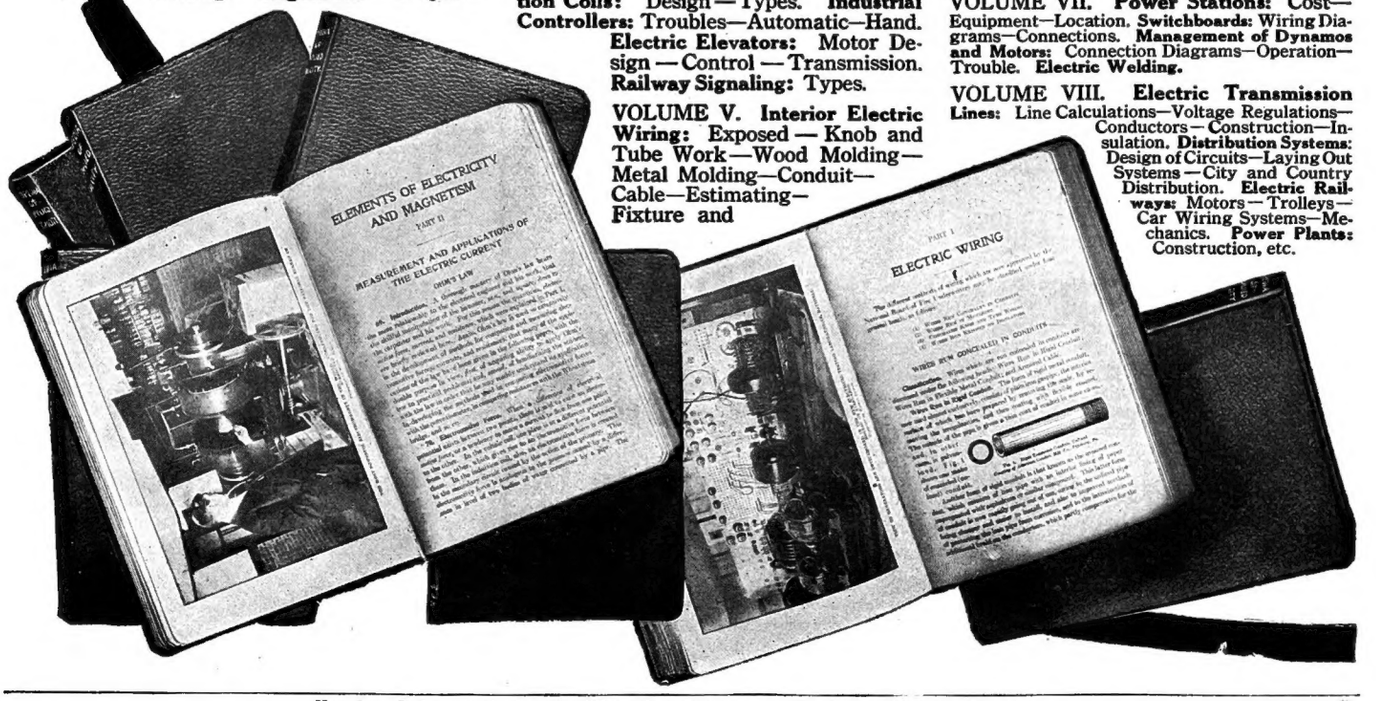
VOLUME IV. **Electrical Measurements and Meter Reading:** Instruments—Methods—Voltage—Current—Testing—Watt-Hour Meters. **Electromagnets and Induction Coils:** Design—Types. **Industrial Controllers:** Troubles—Automatic—Hand. **Electric Elevators:** Motor Design—Control—Transmission. **Railway Signaling:** Types.

VOLUME V. **Interior Electric Wiring:** Exposed—Knob and Tube Work—Wood Molding—Metal Molding—Conduit—Cable—Estimating—Fixture and Fixture Wiring—Theatres—Moving Picture Machines—Materials. **Underwriters Requirements:** National Electric Code—**Outside Wiring:** High-tension Lines—Ground Circuits—Controlling and Protecting Devices.

VOLUME VI. **Electric Lighting:** Planning Systems—Cost—Estimating. **Interior Lighting:** Offices—Stores—Windows—Factories—Residences. **Exterior Lighting: Railway Car Lighting:** Material—Maintenance. **Applied Electrochemistry:** Electric Furnaces—Metal Refining.

VOLUME VII. **Power Stations:** Cost—Equipment—Location. **Switchboards:** Wiring Diagrams—Connections. **Management of Dynamos and Motors:** Connection Diagrams—Operation—Trouble. **Electric Welding.**

VOLUME VIII. **Electric Transmission Lines:** Line Calculations—Voltage Regulations—Conductors—Construction—Insulation. **Distribution Systems:** Design of Circuits—Laying Out Systems—City and Country Distribution. **Electric Railways:** Motors—Trolleys—Car Wiring Systems—Mechanics. **Power Plants:** Construction, etc.



Electricity

Electricity of Tomorrow
Very Latest Methods

THIS is the 1920 edition—new from cover to cover—every one of the eight big volumes is chuck full of the latest methods and discoveries in this fascinating field. 27 of the greatest electrical engineers and experts in the business wrote these books just to help you who are interested in electricity realize your ambitions. To make you successful. It's not one man's ideas and experience, but the combined knowledge of the world's greatest electrical master minds. The seven volumes bound in genuine, flexible American Morocco, contain 3800 pages and more than 3000 pictures, diagrams, etc., illustrating everything known to electricity. See the list of things the books teach you—the list of big jobs that are open to men with the "know how" and our FREE offer that puts the whole set in your home for a week without costing you a cent.

Big Pay for Trained Men

Jobs paying from $1500.00 to $5000.00 yearly are waiting for men who can qualify as Electrical Engineers—Substation Operators—Trouble Men—Switchboard Operators—Dynamo Tenders—Electricians

Practical Knowledge Always in Demand

Electricity is the greatest force in the world and it is growing bigger and bigger every day. The multitude of uses it is now put to and the marvelous things it does for us is as nothing compared to what it will be in a few years from now. Just think what it means to us in our simple daily life. It runs our street cars and automobiles. It makes the telephone and tele graph possible. It lights our homes and gives us the "movies" too. Thousands of men—highly paid men—are needed to handle this wonderful force. Why don't you get into this big paying field now?

Good Jobs Waiting for Men Who Know

If you are trained in some branch of electricity you will never have to look for a job. The job and the big pay that goes with it will be looking for you. You can't dodge a good job if you have the "know how" under your hat. Don't go along year after year depending on a small raise now and then. It takes a lifetime to get you anywhere that way. Learn electricity and JUMP ahead. Let these 27 great engineers help you on your way with their books. Sending the coupon below is your first jump on the road to real success.

FREE Examination—No Risk

You can have this wonderful library to use in your own home or shop for a whole week FREE. It won't cost you one cent. DON'T SEND ANY MONEY. Just fill out and mail the coupon today and the entire set of eight volumes will come to you by express collect. You be the judge and find out for yourself what the books will do for YOU. Use them as you please. Go into every volume thoroughly. Show them to your friends and get their opinion. Then, if you have any doubt about their value, send them back at our expense; you won't owe us anything. If you like the books after a week's examination, you pay us only $2.00 and the same amount every month until $24.80 is paid. This is only 50 cents a week or 7 cents a day. Most of us waste more than this every day of our lives. Can you afford to pass up a better job and higher wages when it costs only 7 cents a day for a short time to get it? Of course you can't. **Mail the Coupon Now—TODAY.**

Only 7 cents a day

Special Offer!

A membership in this Society costs $12.00 a year, but we will give a one year membership FREE to everyone who buys a set of these books. This gives you the right to consult the engineers the Society retains on any electrical subject at any time. Write as often as you please. Ask as many questions as you please.

American Technical Society Dept. E-256 Chicago

AMERICAN TECHNICAL SOCIETY, Dept. E-256 Chicago

Send me the eight volume library of PRACTICAL APPLIED ELECTRICITY for a week's free examination by express collect. I will either send you $2.00 within a week as first payment and $2.00 each month until $24.80 is paid, or return the books at your expense. If I keep the books I am entitled to a one year membership in your Society free.

Name.....

Address.....

Reference..... (Please fill out all three lines.)

No-Money Coupon

"THE 100% WIRELESS MAGAZINE"

CONTENTS OF SEPTEMBER ISSUE:

Grand Opera by Wireless. By H. Gernsback.
Guarding the Ether During the War. By P H. Boucheron.
Construction of an Audion "B" Storage Battery. By Herbert Webb.
Static Eliminator of Considerable Merit. By Edgar Terrain Johnstone.
Wireless Telegraphy with the Canadians at the Front. By J. W. Caucor.
The Double Deck Receiver.
A. B. C. of Wireless Reception. By H. K. Dunn.
The Latest Design Antenna Switch. By E. T. Jones.
The Lure of Radio. By Eugene Dynner.
Some Real Ideas.
Wrinkles for the Experimenter. By W. Hanlon.
A Pocket Size Receiver. By J. E. Aiken.
Value of the Radio Compass. By L. A. Pollock.
Use of Screws, Drills and Taps in Radio Construction. By J. Stanley Brown.
Junior Radio Course—Lesson 1. By E. T. Jones.
Club Gossip.
Questions and Answers.
Radio Digest.
Latest Radio Patents.
Junior Section.

What "Radio Amateur News" Is:

With its third issue RADIO AMATEUR NEWS holds the field undisputedly as the greatest radio magazine in print today. In point of circulation, number of articles, illustrations, RADIO AMATEUR NEWS now leads all other wireless magazines. Take for instance the August issue with its forty-eight pages; there were thirty-nine separate purely radio articles and 115 illustrations. *Over twenty thousand copies were printed and circulated.*

Each issue of the RADIO AMATEUR NEWS now contains 48 pages (or more) and an artistic cover in two colors. The illustrations average 125 every month and there are from 40 to 50 up-to-date articles, some by our biggest radio scientists, in every issue.

RADIO AMATEUR NEWS is the greatest and biggest radio magazine in print today.

RADIO AMATEUR NEWS is the only INDEPENDENT monthly wireless magazine in existence. It caters to no commercial interests—it has no boss save its readers. It is "different"—it has the latest radio news. It is a scientific magazine but it caters largely to the RADIO AMATEUR—it is by and for the Amateur. It is publisht by the publishers of the ELECTRICAL EXPERIMENTER, but there will be no duplication of articles in the two magazines. Both are entirely different—but both together will give you ALL the radio news of all the world. Whether you are a professor or an Amateur, get a sample copy or order it from your Newsdealer today.

Junior Radio Course By E. T. JONES Associate Editor

A distinctly new feature begins with the September issue in our new **Junior Radio Course.** In this issue Lesson No. 1 will appear complete. This course is intended for the beginner and everything presented will be in plain English, even the merest tyro in radio will find no trouble in understanding and assimilating the knowledge. The series is a very important one and nothing like it has ever appeared in print before. Everyone owes it to himself in this new age to know something about wireless and this course will enlighten all laymen. Profusely illustrated with pictures that anyone can understand.

15c The Copy

$1.50 A Year

Canada and Foreign $2.00 A Year

SEND 15c FOR SAMPLE COPY TODAY

48 PAGES
125 ILLUSTRATIONS

SPECIAL OFFER

Gentlemen:

Please enter my subscription for RADIO AMATEUR NEWS for the term of one year for which I enclose herewith $1.50. For this you will send to me immediately your great Wireless Course, containing 160 pages, 350 illustrations, size 6¾ x 10" with fine flexible cloth cover. I have added 5c extra for postage. (I have written my name and address in margin below.)

EXPERIMENTER PUB. CO., 231 Fulton St., N. Y. C.

Miss Evelyn Gosnell
in "Up in Mabel's Room"

Are You a Blond?

The Secret of Making People Like You

Wallace Reid
Star in "The Valley of the Giants"
A Paramount-Artcraft Picture

THE greatest asset any man can possibly have is the faculty for making people like him. It is even more important than ability.

The secret of making people like you lies in your ability to understand the emotional and mental characteristics of the people you meet.

Did you know that a blonde has an entirely different temperament than a brunet?—that to get along with a blond type you must act entirely different than you would to get along with a brunet?

When you really know the difference between blonds and brunets, the difference in their characters, temperaments, abilities and peculiar traits you will save yourself many a mistake—and you will incidently learn much you never knew before about yourself.

* * * * * * *

PAUL GRAHAM was a blond, and not until he learned that there was all the difference in the world between the characteristics of a blond and those of a brunet did he discover the secret of making people like him.

Paul had been keeping books for years for a large corporation which had branches all over the country. It was generally thought by his associates that he would never rise above that job. He had a tremendous ability with figures—could wind them around his little finger—but he did *not* have the ability to mix with big men; did *not* know how to make people like him.

Then one day the impossible happened. Paul Graham became popular.

Business men of importance who had formerly given him only a passing nod of acquaintance suddenly showed a desire for his friendship. People—even strangers—actually went out of their way to do things for him. Even *he* was astounded at his new power over men and women. Not only could he get them to do what he wanted them to do, but they actually anticipated his wishes and seemed eager to please him.

From the day the change took place he began to go up in business. Now he is the Head Auditor for his corporation at an immense increase in salary. And all this came to him simply because he learned the secret of making people like him.

You, too, can have the power of making people like you. For by the same method used by Paul Graham, you can, at a glance, tell the characteristics of any man, woman or child—tell instantly their likes and dislikes, and YOU CAN MAKE PEOPLE LIKE YOU: Here is how it is done.

Everyone you know can be placed in one of two general types—blond or brunet. There is as big a difference between the mental and emotional characteristics of a blond and those of a brunet as there is between night and day. You persuade a blond in one way—a brunet in another. Blonds enjoy one phase of life—brunets another. Blonds make good in one kind of a job—brunets in one entirely different.

To know these differences scientifically is the first step in judging men and women; in getting on well with them; in mastering their minds; in making them like you; in winning their respect, admiration, love and friendship.

And when you have learned these differences—when you can tell at a glance just what to do and say to make any man or woman like you, your success in life is assured.

For example, there's the case of a large manufacturing concern. Trouble sprang up at one of the factories. The men talked strike. Things looked ugly. Harry Winslow was sent to straighten it out. On the eve of a general walkout he pacified the men and headed off the strike. And not only this, but ever since then, that factory has led all the others for production. He was able to do this, because he knew how to make these men like him and do what he wanted them to do.

Another case, entirely different, is that of Henry Peters. Because of his ability to make people like him—his faculty for "getting under the skin" and making people think his way, he was given the position of Assistant to the President of a large firm. Two other men, both well-liked by their fellow employees, had each expected to get the job. So when the outside man, Peters, came in, he was looked upon by everyone as an interloper and was openly disliked by every other person in the office.

Peters was handicapped in every way. But in spite of that, in three weeks he had made fast friends of everyone in the house and had even won over the two men who had been most bitter against him. The whole secret is that he could tell in an instant how to appeal to any man and make him well-liked.

A certain woman who had this ability moved with her family to another town. As is often the case, it is a very difficult thing for any woman to break into the chill circle of society in this town, if she was not known. But her ability to make people like her soon won for her the close friendship of many of the "best families" in the town. Some people wonder how she did it. It was simply the secret at work—the secret of judging people's character and making them like you.

* * * * * * *

YOU realize, of course, that just knowing the difference between a blond and a brunet could not accomplish all these wonderful things. There are other things to be taken into account. But here is the whole secret.

You know that everyone does not think alike. What one likes another dislikes. What pleases one offends another. And what offends one pleases another. Well, there is your cue. You can make an instant "hit" with anyone, if you say the things they want you to say, and act the way they want you to act. Do this and they will surely like you and believe in you and will go miles out of their way to PLEASE YOU.

You can do this easily by knowing certain simple signs. In addition to the difference in complexion, every man, woman and child has written on them signs as distinct as though they were in letters a foot high, which show you from one quick glance exactly what to say and to do to please them—to get them to believe what you want them to believe—to think as you think—to do exactly what you want them to do.

Knowing these simple signs is the whole secret of getting what you want out of life—of making friends, of business and social advantage. Every great leader uses this method. That is why he IS a leader. Use it yourself and you will quickly become a leader—nothing can stop you.

You have heard of Dr. Blackford, the Master Character Analyst. Many concerns will not employ a man without first getting Dr. Blackford to pass on him. Concerns such as Westinghouse Electric and Manufacturing Company, Baker, Vawter Company, Scott Paper Company and many others pay Dr. Blackford large annual fees for advice on dealing with human nature.

So great was the demand for these services that Dr. Blackford could not even begin to fill all the engagements. So Dr. Blackford has explained the method in a simple, seven-lesson course, entitled, "Reading Character at Sight." Even a half hour's reading of this wonderful course will give you an insight into human nature and a power over people which will surprise you.

Such confidence have the publishers in Dr. Blackford's course, "Reading Character at Sight," that they will gladly send it to you on approval, all charges prepaid. Look it over thoroughly. See if it lives up to all the claims made for it. If you do not want to keep it, then return it and the transaction is closed. And if you decide to keep it—as you surely will—then merely remit five dollars in full payment.

Remember, you take no risk, you assume no obligation. The entire course goes to you on approval. You have everything to gain—nothing to lose. So mail the coupon NOW, and learn how to make people like you, while this remarkable offer is still open.

FREE EXAMINATION COUPON

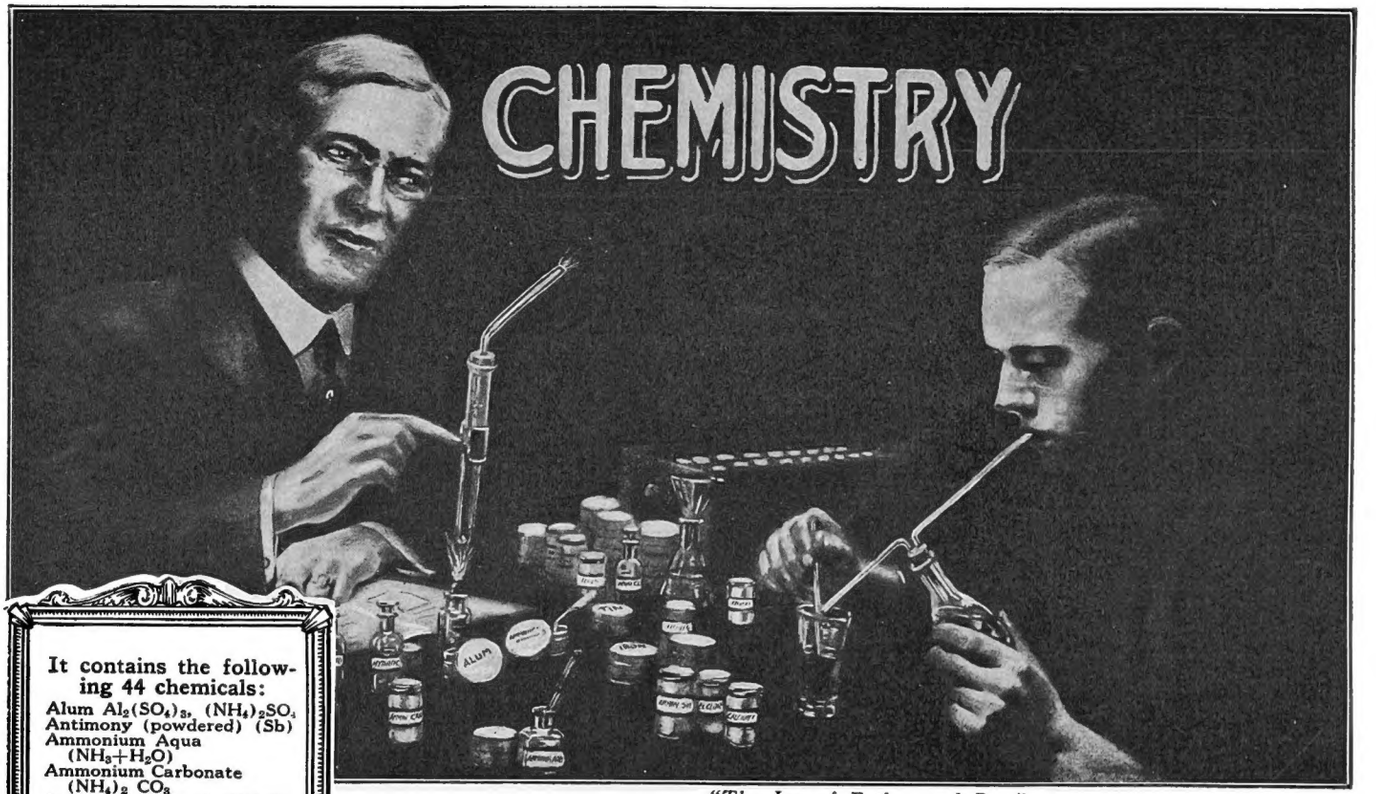
Independent Corporation
Publishers of The Independent Weekly
Dept. B-1109, 119 West 40th Street, New York

You may send me Dr. Blackford's Course of seven lessons entitled "Reading Character at Sight." I will either remail the course to you within five days after its receipt, or send you $5 in full payment of the course.

Name .....

Address .....

.....Elect. Exper. 9-19



"The Joy of Father and Boy."

Chemical Laboratory

We present herewith to our friends our new **E. I. Co. Chemical Laboratory** which contains **real** chemicals and apparata to perform **real** chemical experiments. This outfit is not a toy, put up merely to amuse, but a practical laboratory set, with all the chemicals, apparata and reagents necessary to perform real work and to teach the beginner all the secrets of inorganic chemistry. With this outfit we give free a book containing a **Treatise in Elementary Chemistry, useful data and recipes, and 100 instructive and amusing experiments.**

It contains the following 44 chemicals:

Alum $Al_2(SO_4)_3$, $(NH_4)_2SO_4$
Antimony (powdered) (Sb)
Ammonium Aqua (NH_3+H_2O)
Ammonium Carbonate $(NH_4)_2\ CO_3$
Ammonium Chloride (NH_4Cl)
Ammonium Sulphate $(NH_4)_2\ SO_4$
Barium Chloride ($BaCl_2$)
Boric Acid (H_3BO_3)
Brimstone (Sulphur) (S)
Calcium Chloride ($CaCl_2$)
Calcium Oxide (CaO)
Calcium Sulphate ($CaSO_4 2H_2O$)
Charcoal (Carbon) (C)
Chloride of Zinc ($ZnCl_2$)
Copper Sulphate ($CuSO_4$)
Ferrous Sulphate ($FeSO_4$)
Ferrous Sulphide (FeS)
Glycerol (Glycerine) $C_3H_5(OH)_3$
Hydrochloric Acid (HCl)
Iodine (I)
Iron Chloride ($FeCl_2$)
Iron Oxide (Fe_2O_3)
Lead Acetate Pb $(C_2H_3O_2)_2$
Litmus Paper
Magnesium Carbonate ($MgCO_3$)
Manganese Dioxide (MnO_2)
Mercury (Quicksilver) (Hg)
Nickel Chloride ($NiCl_2$)
Oxalic Acid ($H_2C_2O_4$)
Sodium Bicarbonate ($NaHCO_3$)
Sodium Borate ($NaBO_2$)
Sodium Carbonate (Na_2CO_3)
Sodium Chloride (NaCl)
Sodium Nitrate ($NaNO_3$)
Sodium Phosphate (Na_2HPO_4)
Sodium Sulphate (Na_2SO_4)
Sodium Sulphite (Na_2SO_3)
Stannous Chloride ($SnCl_2$)
Sulphate of Nickel ($NiSO_4$)
Sulphate of Zinc ($ZnSO_4$)
Sulphuric Acid (H_2SO_4)
Tin (Granulated) (Sn)
Zinc (Metal) (Zn)
Zinc Carbonate ($ZnCO_3$)

The following apparata are furnished:

One Standard Washbottle
One Alcohol Lamp
One Conical Glass Measure
One Erlenmeyer Flask
One Glass Funnel
One Delivery Tube
Six Assorted Test-Tubes
One Test-Tube Holder
Ten Sheets of Filter Paper
One Glass Dropper
One Spoon Measure
Glass Tubing
One book containing Treatise on Elementary Chemistry and 100 Chemical Experiments to be performed with this outfit.

DESCRIPTION OF THE OUTFIT:

The outfit consists of forty-four (44) Chemicals all C. P. (chemical pure) put up in appropriate wooden boxes, glass bottles, and hermetically closed jars. The acids are put up in glass bottles, with ground-in glass stoppers and there is a sufficient quantity of chemicals supplied (mostly one to two ounces) enough to make dozens of experiments with each. See list of Chemicals herewith.

The apparata furnished are all of the best obtainable make and of standard laboratory size and shape. A list of the 17 pieces of apparata furnished with this outfit is printed also herewith.

The Instruction book is a real **Chemistry Course for the Beginner.** Some of the Contents are: **Division of Matter:** This is a Treatise on Elementary Chemistry and deals with the theory of the Elements, Molecules and Atoms, etc. **Chemical Nomenclature:** This explains in simple language the derivation of the chemical names of the Elements and their compounds. There is a chapter on **Laboratory Operations; Glass Working; First Aid; Fire Extinguishers; Experimenters' Aphorisms,** etc.

A good part of the book is devoted to Weights and Measures. The Metric System, the English system and the U. S. System are fully explained.

The following tables are furnished: Symbols and Atomic weights of the Elements; Measures of Weights, Volume, Capacity and Length; Per Cent solutions; Conversion of Measure expressed in parts; Poisons and their antidotes; Technical and common name of chemical substances; Formulas for Cleaning various substances, etc., etc.

Among the **100 Experiments** are:

How to make chemical tricks; How to make invisible and magic inks; How to test flour; How to test soil; How to Make Chlorine Gas and smoke (German War Gas); How to bleach cloth and flowers. How to produce Oxygen and Hydrogen; How to make chemical colors; How to test Acids and Alkalies and hundreds of interesting hints and formulas.

The price is still $5.00. Shipping Weight 10 lbs. (Can be shipped by Express only.)

THE ELECTRO IMPORTING CO., Mfrs.
TRADE MARK **231 FULTON STREET NEW YORK CITY** TRADE MARK

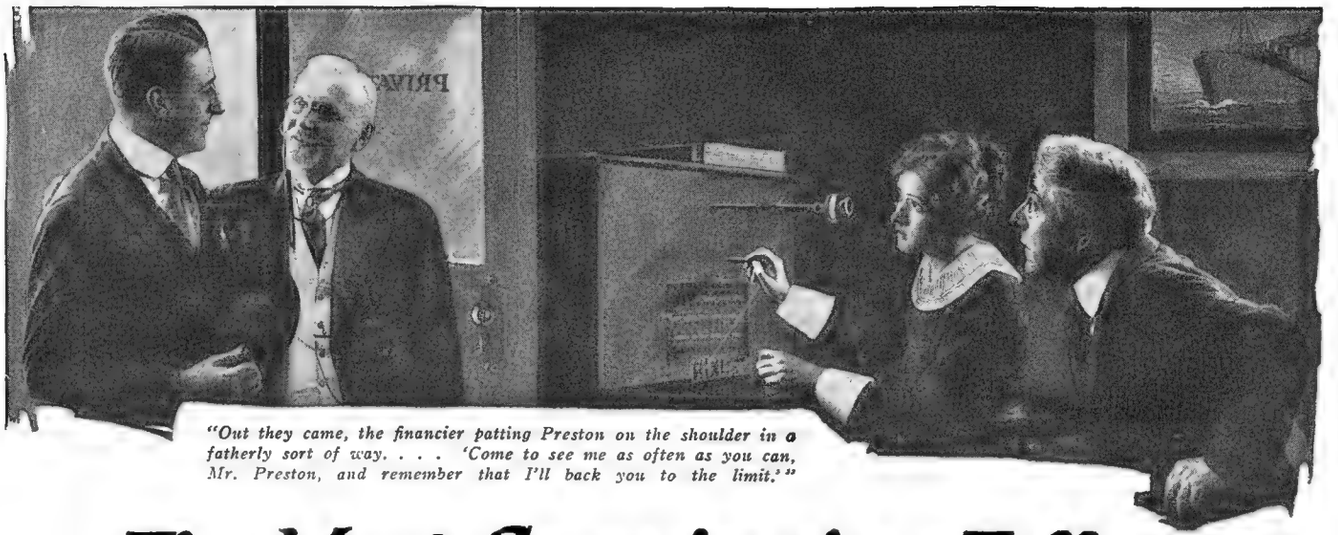
ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

I enclose herewith 6 cents in stamps or coin, to cover postage, for which please send me your latest Cyclopedia Catalog No. 20 as described.

NAME .....
ADDRESS .....
STATE.....E. E. 9-19

"THE LIVIEST CATALOG IN AMERICA"

Our big, new electrical cyclopedia No. 20 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 176 Big Pages, 400 illustrations. 300 instruments and apparatus, etc. Big **"Treatise on Wireless Telegraphy."** 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 20 measures 7x5¼". Weight ½ lb. Beautiful stiff covers.



"Out they came, the financier patting Preston on the shoulder in a fatherly sort of way. . . . 'Come to see me as often as you can, Mr. Preston, and remember that I'll back you to the limit.'"

The Most Convincing Talker I Ever Met

Everywhere this man goes, people shower him with favors and seek his friendship. Things which other people ask for and are refused, he gets instantly. How he does it is told in this amazing story.

LET me ask you this: There is a big business deal to be put through. It involves millions of dollars. Putting it through depends wholly on one thing—getting the backing of a great financier.

But this man is bitterly opposed to your idea and to your associates. Seven of the most able men and women in all America have tried to win over this financier. They failed dismally and completely.

Now, could you, a total stranger to this man, walk in on him unannounced, talk for less than an hour, and then have him take your arm as a token of friendship, and give you a signed letter agreeing to back you to the limit?

Could you?

ASTOUNDING? Yes! But it *WAS* done. And I'll tell you how. Here is the way it all came about. For a long time the directors of our company had felt the handicap of limited capital. We had business in sight running into a million dollars a month. But we couldn't finance this volume of sales. We simply had to get big backing, and that was all there was to it.

Because of trade affiliations, one man—a great financier in New York—controlled the situation. Win him over and the rest was easy. But how to win him?—that was the question. No less than five men and two women—all people of influence and reputation—had tried. They were all repulsed—turned down cold and flat.

You know how a thing of this sort grows on you and how bitter utter defeat is. Well, we were talking it over at a board meeting when one of our directors announced that he knew of only one man who could possibly put through the deal—a man by the name of Preston.

So it was agreed that Preston was to be sounded out at luncheon the following day. He proved to be a fine type of American. At 34 years of age he had become president and majority stockholder of a thriving manufacturing business rated at three-quarters of a million dollars.

Preston was deeply interested, as anyone would be over the prospect of closing such a big deal. The director in question said casually, "Why don't you run down to New York and take a shot at it, Preston?" Preston looked out of the window for a moment, and then quietly answered, "You're on."

I WENT along with Preston simply as a matter of form to represent our interests. Aboard the 10:25 train out of Chicago we headed for the smoker and got to talking with the crowd there.

Then I noticed something. Preston had dominated them all. Everyone was eagerly hanging on his words, and looking at him with open admiration. No sooner would he stop talking than one of the men would start him up again. And as the men dropped off at stations along the way they gave Preston their cards, with pressing invitations to look them up. No doubt about it, Preston was *THE* man aboard that car.

The colored porter, too, came under his sway. For that night, when the berths were being made up, the porter came unasked to Preston, told him that his berth was right over the car trucks, and insisted upon changing it to a more comfortable one.

And so it went all the way to New York. Everyone who met Preston took a great liking to him the instant he spoke. They seemed to be eager for his companionship—wanted to be with him every minute, openly admired him, and loaded him with favors.

Even the usual haughty room clerk at the hotel showed a great interest in Preston's welfare. He showered us with attention while a long line of people waited to register.

The next morning we called on the great financier—the man who was so bitterly against us and had flatly turned down seven of our shrewd influential representatives.

I waited in the reception room—nervous, restless, with pins and needles running up and down my spine. Surely Preston would meet the same humiliating fate?

But no! In less than an hour out they came, arm in arm, the financier patting Preston on the shoulder in a fatherly sort of way. And then I heard the surprising words, "Come to see me as often as you can, Mr. Preston, *and remember that I'll back you to the limit!*"

AT the hotel that night sleep wouldn't come. I couldn't get the amazing Preston out of my thoughts. What an irresistible power over men's minds he had. Didn't even have to ask for what he wanted! People actually competed for his attention, anticipated his wishes and eagerly met them. What a man! What power! . . . Then the tremendous possibilities of it all—think what could be done with such power!

What was the secret? For secret there must be. So the first thing next morning I hurried to Preston's room, told him my thoughts, and asked him the secret of his power.

Preston laughed good-naturedly. "Nothing to it—I—well—that—is—" he stalled. "I don't like to talk about myself, but I've simply mastered the knack of talking convincingly, that's all."

"But how did you get the knack?" I persisted.

Preston smiled, and said, "Well, there's an organization in New York that tells you exactly how to do it. *It's amazing!* There's really nothing to study. It's mostly a knack which they tell you. You can learn this knack in a few hours. And in less than a week it will produce definite results in your daily work.

"Write to this organization—The Independent Corporation—and get their method. They send it on free trial. I'll wager that in a few weeks from now you'll have a power over men which you never thought possible . . . but write and see for yourself." And that was all I could get out of the amazing Preston.

WHEN I returned home I sent for the method Preston told me about. It opened my eyes and astounded me. Just how he had won over the financier was now as clear as day to me. I began to apply the method to my daily work, and soon I was able to wield the same remarkable power over men and women that Preston had. I don't like to talk about my personal achievements any more than Preston does, but I'll say this:

When you have acquired the knack of talking convincingly, it's easy to get people to do anything you want them to do. That's how Preston impressed those people on the train—how he got special attention from the hotel clerk—how he won over the financier—simply by talking convincingly.

This knack of talking convincingly will do wonders for any man or woman. Most people are afraid to express their thoughts; they know the humiliation of talking to people and of being ignored with a casual nod or a "yes" or "no." But when you can talk convincingly, it's different. *When you talk people listen and listen eagerly.* You can get people to do almost anything you want them to do. And the beauty of it all is that they think they are doing it of their own free will.

In committee meetings, or in a crowd of any sort you can rivet the attention of all when you talk. You can force them to accept your ideas. It helps wonderfully in writing business letters—enables you to write sales letters that amaze everyone by the big orders they pull in.

Then again it helps in social life. Interesting and convincing talk is the basis of social success. At social affairs you'll always find that the convincing talker is the centre of attraction, and that people go out of their way to "make up" to him.

Talk convincingly and no man—no matter who he is—will ever treat you with cold, unresponsive indifference. Instead, you'll instantly get under his skin, make his heart glow and set fire to his enthusiasms. Talk convincingly and any man—even a stranger—will treat you like an old pal and will literally take the shirt off his back to please you.

You can get anything you want if you know how to talk convincingly. You've noticed that in business ability alone won't get you much. Many a man of real ability, who cannot express himself well, is often outdistanced by a man of mediocre ability who knows how to talk convincingly. There's no getting away from it, to get ahead—merely to hold your own—to get what your ability entitles you to, *you've got to know how to talk convincingly!*

THE method Preston told me about is Dr. Law's "Mastery of Speech," published by the Independent Corporation. Such confidence have the publishers in the ability of Dr. Law's method to make you a convincing talker that they will gladly send it to you wholly on approval.

You needn't send any money—not a cent. Merely mail the coupon, or write a letter, and the complete Course "Mastery of Speech," will be sent you by return mail, all charges prepaid. If you are not entirely satisfied with it, send it back any time within five days after you receive it and you will owe nothing.

But if it pleases you, as it has pleased thousands of others, then send only five dollars in full payment. You take no risk. You have everything to gain and nothing to lose. So mail the coupon now before this remarkable offer is withdrawn.

Independent Corporation

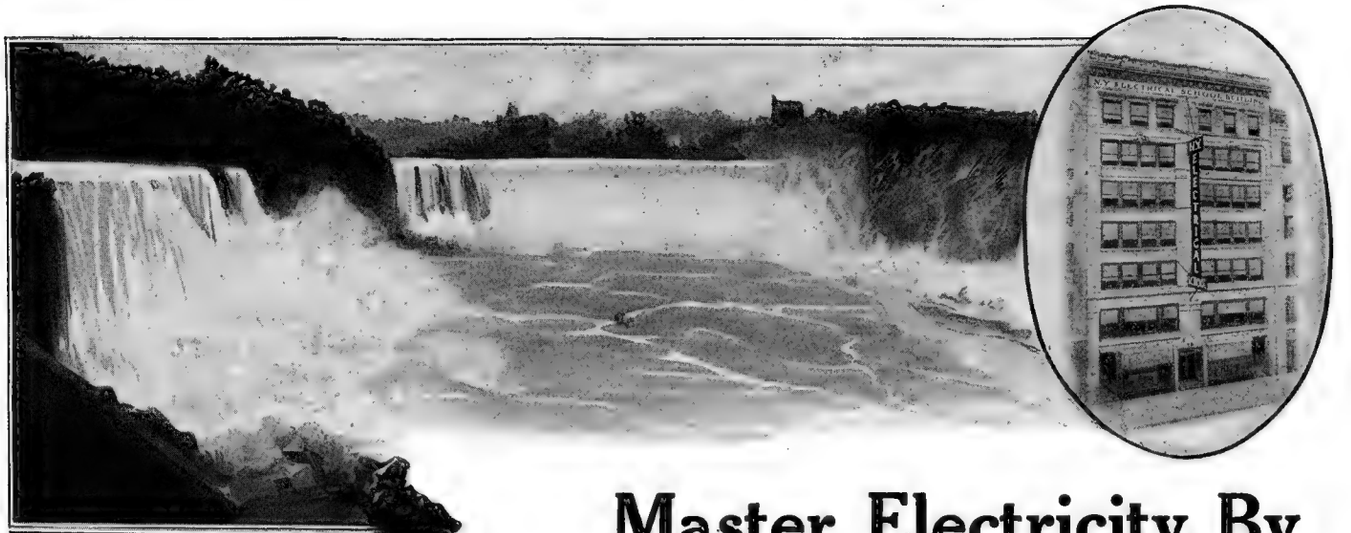
Publishers of the Independent Weekly

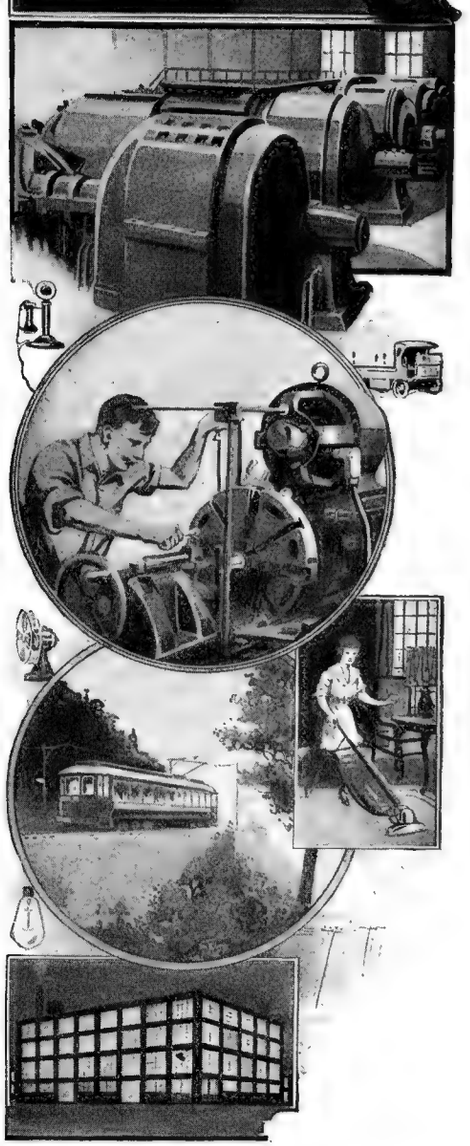
Dept L1109 119 W. 40th St. New York

Please send me Dr. Frederick Houk Law's "Mastery of Speech," a Course in Business Talking and Public Speaking in eight lessons. I will either remail the Course to you within five days after its receipt, or send you $5 in full payment of the Course.

Name .....

Address .....Elect. Exper. 9-19





Master Electricity By Actual Practice

The only way you can become an expert is by doing the very work under competent instructors, which you will be called upon to do later on. In other words, *learn by doing.* That is the method of the New York Electrical School.

Five minutes of actual practice properly directed is worth more to a man than years and years of book study. Indeed, Actual Practice is the only training of value, and graduates of New York Electrical School have proved themselves to be the only men that are fully qualified to satisfy EVERY demand of the Electrical Profession.

The Only Institution of the Kind in America

At this "Learn by Doing" School a man acquires the art of Electrical Drafting; the best business method and experience in Electrical Contracting, together with the skill to install, operate and maintain all systems for producing, transmitting and using electricity. A school for Old and Young. Individual instruction.

Over 5,500 Graduates are Successful Men in the Electrical World

No previous knowledge of electricity, mechanics or mathematics is necessary to take this electrical course. You can begin the course now and by steady application prepare yourself in a short time. You will be taught by practical electrical experts with actual apparatus, under actual conditions.

Special Automobile Ignition Course

We have just installed a special automobile ignition course for auto mechanics, garage men and owners. The course covers completely ignition, starting, lighting and other electrical equipment in connection with automobiles, motor boats, etc.

Let us explain our complete courses to you in person. If you can't call, send now for 64-page book—it's FREE to you.

New York Electrical School
29 W. 17th St., New York, N. Y.

Please send FREE and without obligation to me your 64-page book.

----------(NAME)

----------(ADDRESS)

New York Electrical School

29 West 17th Street, New York

ELECTRICAL EXPERIMENTER

H. GERNSBACK – EDITOR
H. W. SECOR – ASSOCIATE EDITOR

Vol. VII. Whole No. 77 SEPTEMBER, 1919 No. 5

Silhouette Movies

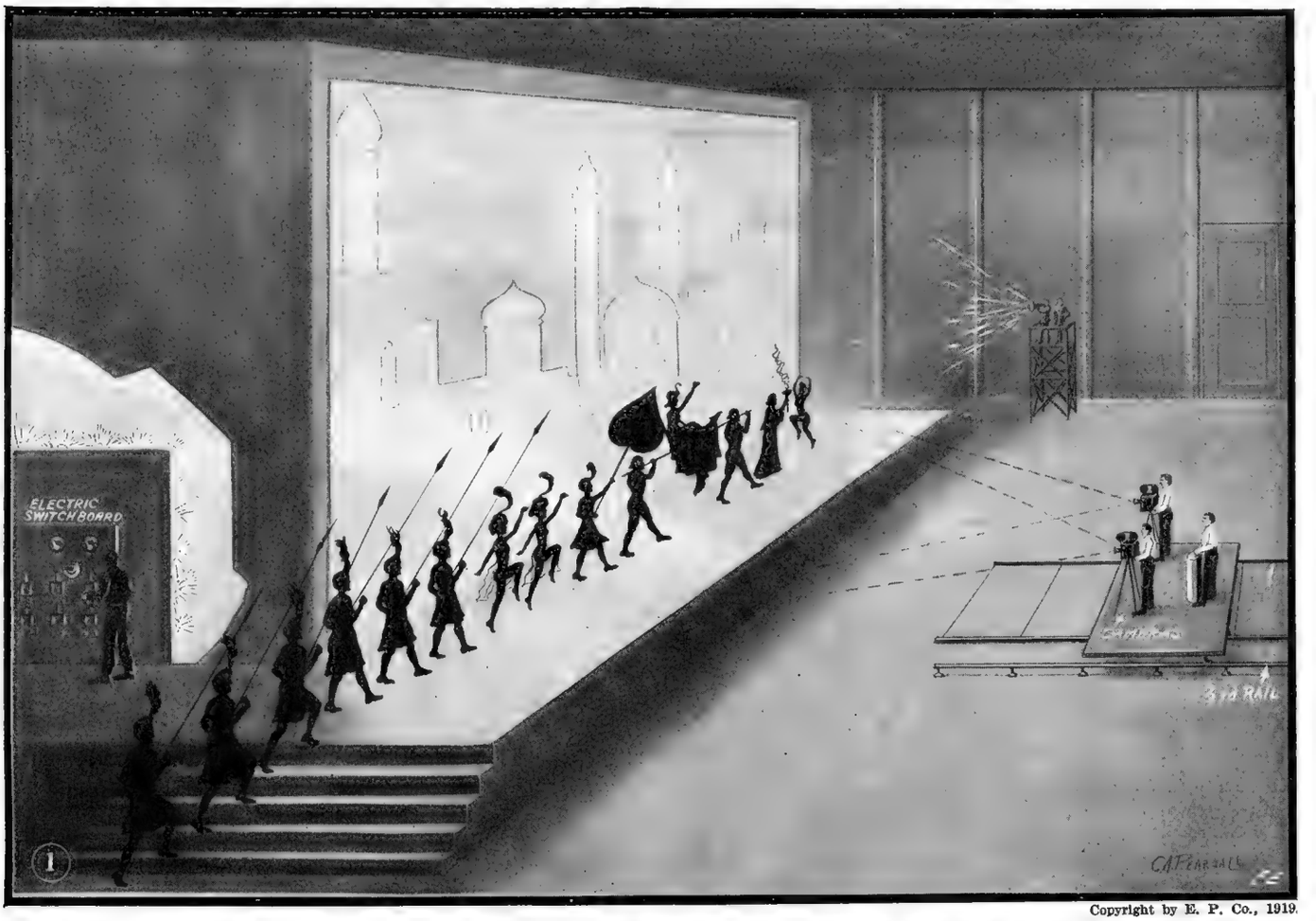
By H. GUMPEL

Mechanical Production of Moving Picture Films in "Silhouette"

PROGRESSIVENESS, combined with resourcefulness and inventive ingenuity, are counting for much to-day in the production of live motion-picture films. The public wants to be entertained during their leisure hours. Something radically new has to take the place of the old, constantly, to suit the "movie" fans and keep the theaters filled. The greatest attractions of to-day will lose their interest and novelty to-morrow. It is therefore self-evident that in this atmosphere of changeability there is a great field open for wide-awake inventors.

The latest novelty in the film world is the photographic production of *silhouette pictures* recently patented by C. A. Gilbert. Pictures of this kind until recently had to be drawn by hand. From fifteen to eighteen individual pictures illustrating the progress in action are needed per second. The individually drawn comic picture is therefore expensive in manufacture.

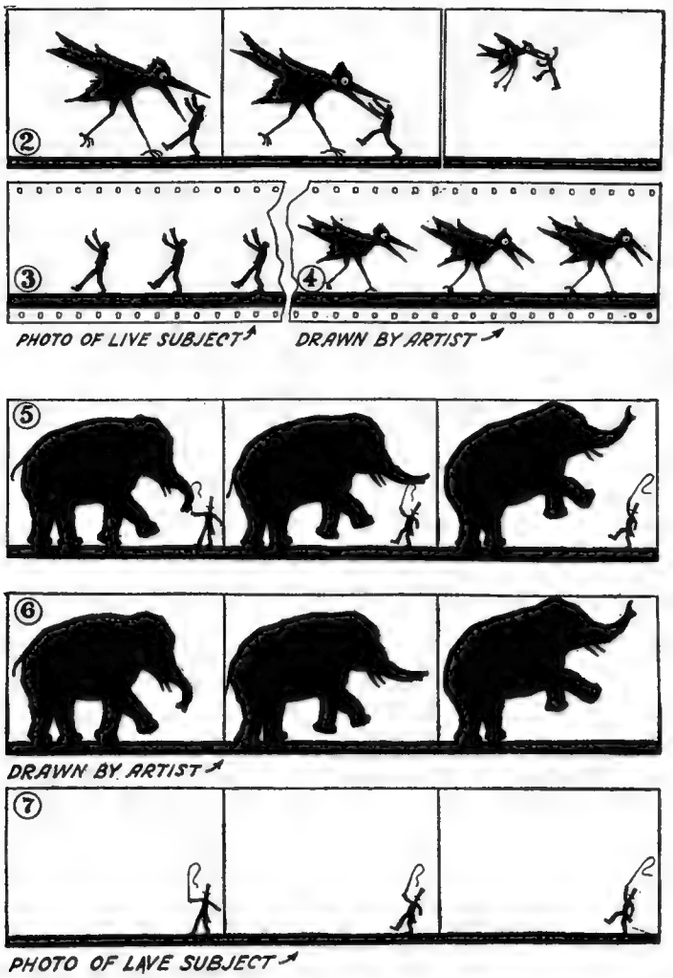
Gilbert is using silhouettes. Since these



Copyright by E. P. Co., 1919.

The Latest in "Silhouette Movies." They Are Made from Life in the Manner Here Illustrated. The Stage Screen Is Highly Illuminated from the Rear and the Actors Appear Before It Drest in Black Clothes. The Camera Car Can Be Rapidly Moved Toward or Away from the Studio Stage by Means of an Electric Motor Attached to the Car Axle and Controlled by the Operators or a Third Man as Shown. Current Is Supplied the Motor Thru a Third Rail.

produce the weird and unusual effect of *black people* moving in a *black world*, they are most suitable for comic pictures.



A New Way to Make Silhouette Movies. The Man in the Pictures Shown Is Photographed as in Fig. 1 from Life, While the Giant Bird and the Elephant Are Drawn by an Artist in the Proper Scale and then Photographed. Figs. 2 and 5 Show the Combined Effects Clearly.

Silhouettes could be produced by shadows thrown on a light screen. Shadows, however, do not produce a sufficiently sharp image. Gilbert's method consists rather of directly photographing the actors. They present the appearance of silhouettes by having their movements performed in front of a powerfully illuminated screen. The method used is shown in figure 1. Here we have a stage upon which actors are moving before the transparent screen, behind which lights are arranged to give the necessary illumination, but without throwing direct light rays thru the screen.

The screen forms the front of a box or small chamber in which the light is produced, but projected from the white painted walls to the screen. The side wings of this box carry banks of powerful electric lights which brilliantly illuminate the rear side of the transparent screen. The arrangement is such as to prevent shadows from falling from actors upon the screen. Their position is indicated in figure 1. If the lights are of sufficient intensity, pictures taken by means of a motion-picture camera in front of the stage, as shown in figure 1, will be in silhouette. This method of producing the pictures presents the advantage of giving the actors entire freedom of movement, without reference to the illuminating arrangement.

Gilbert's method admits of various interesting applications, by which novel effects can be produced. Figure 2, for instance, shows the picture of a tremendous bird eating a man. The actions of the man have been actually picturized (to use the language of the "movie" industry), as shown in figure 3, in a separate film. The bird, however, and his "cruel" actions have been produced by the pen of an artist according to figure 4. Then both films have been combined into the final working film, figure 2, with its weird impressions. In a similar way films, figure 5, of an elephant and his trainer have been composed by combining figures 6 and 7. The trainer has here been an actual man, but the elephant, no matter how natural he may look, has been originated by an artist. In this case it is decidedly more economical to arrive at the elephant's picture by employing the skill of an artist than by having an actual elephant on the stage.

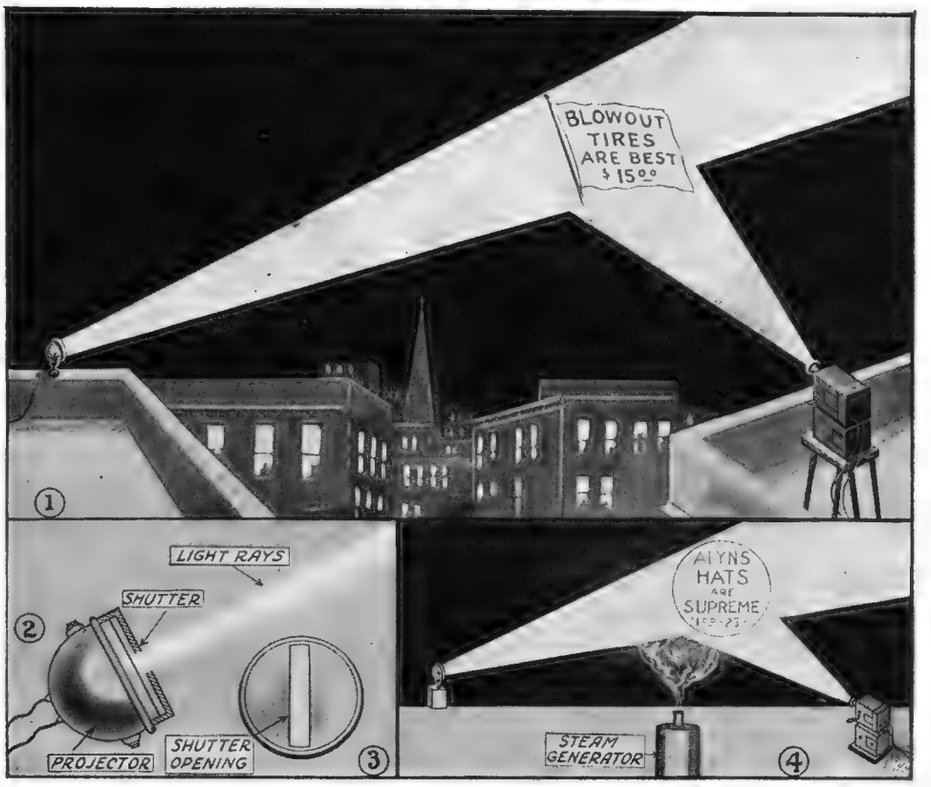
The background of the picture, consisting let us say of buildings, is frequently produced by having a permanent drawing painted on the screen before which the actors appear. A picture of this kind is illustrated in figure 1. In this case it is not necessary to combine two films into one, which naturally adds to the production expenses. It is often possible, however, to make the background a natural picture, such as a street scene, and this can then be combined with a comic silhouette picture produced by means of the Gilbert process.

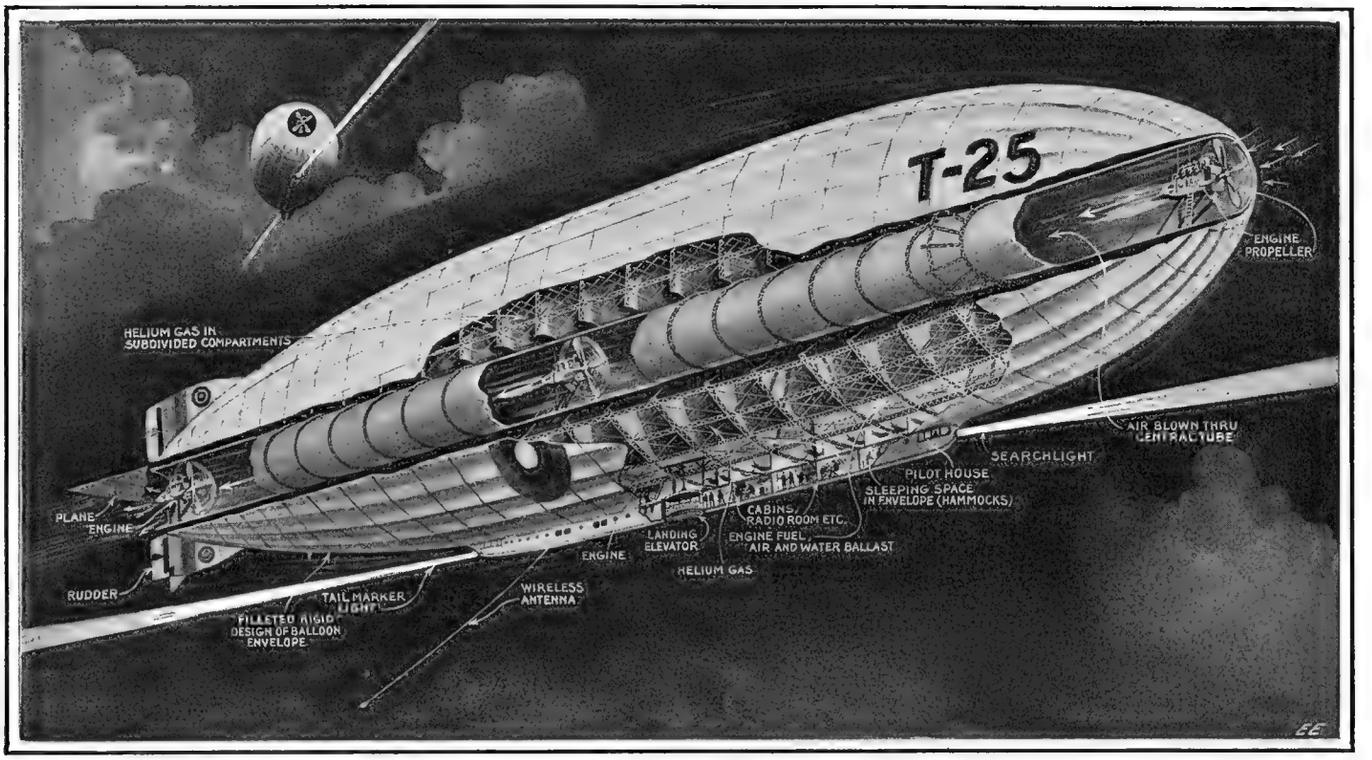
An Electric Sign in Mid-Air

The accompanying illustration shows a recent invention of Mr. Frank H. Ellison, of New York City, who proposes an advertising scheme susceptible to many advertising adaptations whereby two powerful beams of electric light are flashed into space at right angles, causing thereby an image in the form of an advertisement, flag, etc., to be cast up at the juncture of the two beams. The main shaft of light may be thrown from a powerful electric searchlight projector, or other source of intense illumination, while the crosswise beam

The Accompanying Illustration Shows a New Invention, Which Is as Radical as It Is Novel in Its Conception. The Inventor Proposes to Throw an Image of a Flag or an Advertisement in Mid-Air at the Interception of Two Powerful Beams of Light, as Here Illustrated.

projector, carrying the image, may be in the form of a stereopticon, in which different slides can be placed and quickly changed, as desired. In the event that an atmosphere containing water vapor, as in the East, is not available it becomes possible to provide an artificial medium for the purpose, by employing a small steam generator or boiler under the spot where the image is desired. A single steampipe or two may be run a considerable distance above the roof of a high building in the vicinity, and when it is desired to throw the image or script in the air, the steam is turned on and thus forms a very good medium for the purpose.





This Illustration Shows a Recent Development In Simplifying the Airship and at the Same Time Making for More Efficiency all Around. The Idea Is To Do Away Entirely With the Underslung Power Gondolas, Such as are Used on the English and German Airships of the Zeppelin Type. The Engines are Housed in a Wind Tunnel Running Thru the Center of the Airship as Shown. Propellers Which are from Fifteen to Twenty Feet in Diameter Create a Sort of Vacuum Within the Tube, and the Airship Therefore will Virtually Suck Its Way Thru the Air at an Increased Speed.

Speeding Up the Airship

By H. GERNSBACK

ON its historic cruise to the United States the R-34, while making a splendid achievement, disappointed many for the reason that it had been hoped that the dirigible would make a westerly passage much quicker than it actually did. Of course, the airship had to battle against head-winds nearly all the way over, which is best proven by the fact that on its return trip it accomplisht the eastward passage in 75 hours.

One reason, and the entire reason, that Brown and Alcock flew across the ocean in sixteen hours with an airplane, while the quickest trip of the airship took over four times as long, is explained in one word—friction. The airplane offers but little surface to the wind, due to the fact that its surfaces not only are comparatively small, but cutting like a knife, they do not offer much resistance to the air. The airship on the other hand, due to its large and cumbersome bulk, gives rise to enormous friction not only head on, but along its sides as well. In this capacity it stands on a par with the big ocean liner that sinks deep into the water, and consequently needs an enormous power to move it, whereas the little motorboat-hydroplane, when provided with suitable vanes, will actually skim above the water, hardly touching the latter, at a speed many times that of the ocean liner. Here we have the same comparison. It is simply a matter of reduced friction of the mechanical birds and their natural element, the air. We therefore find that if we can do away with all unnecessary friction on the huge airship, we will be able to propel it much faster. Take the case of the R-34 with its four gondolas; these take up quite a good deal of room and make for air resistance when the airship is in flight. While to the layman this appears trifling, it tends to retard the total speed of the airship very considerably, and if we can do away with these gondolas and their engines, we will increase the speed of the airship by just so much.

Also, if we can diminish the resistance created by the nose of the airship as it plows its way thru the air, we will again increase its speed. This, of course, is apparent, and the following experiment, which anyone may try himself, ought to prove it abundantly. Take a pail of water and try to drag it with the open side thru a stream of water. You will meet with an enormous resistance. Take the same pail and make a hole of about half the diameter in the bottom of the pail. You will now find that you can drag the pail with considerable ease, for the reason that the water flows right thru it. In the former experiment it was necessary to first fill the pail with water, and after this move (displace) a column of water represented by the diameter of the pail.

With these things in view, the writer offers a novel idea in which it is proposed to speed up dirigibles considerably. The idea is made clear in the accompanying illustration. It will be seen that this airship has no gondolas whatsoever, and the power plant is not hung underneath the airship, as is common in all Zeppelin types. Instead, the center of the airship is hollow, forming a wind tunnel extending clear thru the entire length of the airship. This air tube, of course, is not a small affair, but is anywhere from 15 to 25 feet in diameter, as will be noted. The three engines are stationed, the first at the nose, the second at the tail end, and the third in the center of the wind tunnel. The propellers must be of the same diameter as that of the tunnel, and the object is to have all three of them working at the same time in order to suck in the air at the nose of the ship and form a sort of vacuum. The air will then flow thru the tunnel, the same as the water flows thru the pail after we made a central opening in its bottom. From this it will be seen that the airship will *virtually suck its way thru the air,* and it should be possible for such a craft to make much greater speed than with the former methods. Moreover, as the engines are not exposed to the elements, it would also seem that not so much engine trouble should develop, as is the case with the under-slung type. Another very important consideration is that inasmuch as the air is rushing right back of the engines, the cooling of the latter is infinitely better than at present. And as every engine man knows, the better an engine is cooled the less likelihood there is of trouble developing.

In the aërial liner of the future, in order to do away with all unnecessary head resistance, the crew's quarters, etc., will probably be located at the bottom of the airship, and as will be noted in the illustration, the entire living quarters are fashioned with stream lines, to minimize all unnecessary air resistance.

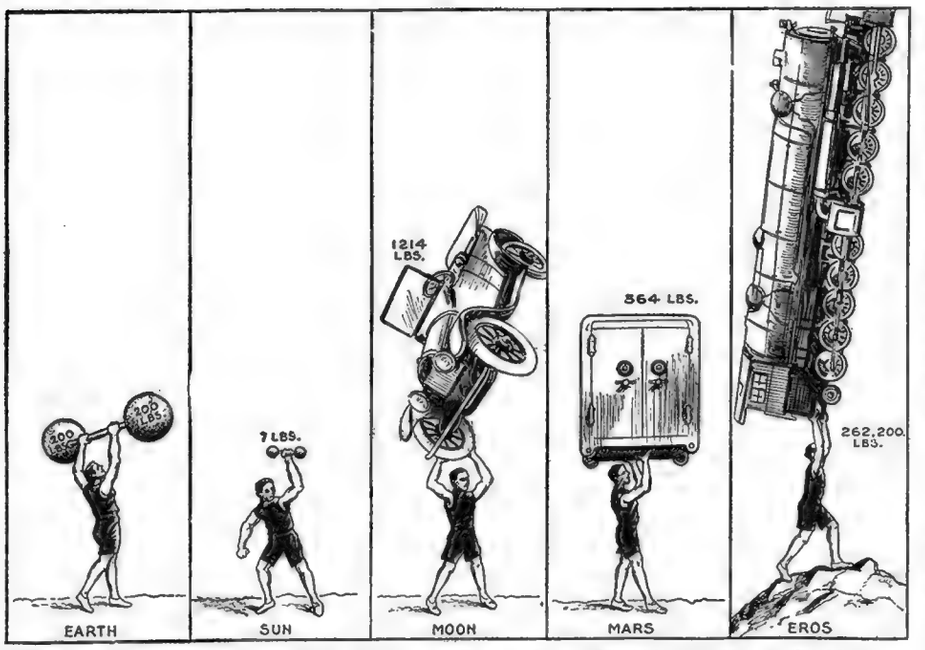
Hydrogen gas will probably not be used much longer, as already Zeppelin types in Germany demonstrated that these huge bags are not safe with the enormous quantities of inflammable gas stored within their metallic girders. Electric sparks set up by the electrical machinery of wireless apparatus are a constant danger to the explosive gas, and the same is true should lightning hit the dirigible. The airship of the future for this reason will use Helium gas in its subdivided compartments, or some other

(*Continued on page* 446)

Popular Astronomy

By ISABEL M. LEWIS
Of the U. S. Naval Observatory

Interesting Phenomena of Gravitation



This Shows Graphically How Much a Human Being Would Be Able to Lift on the Various Heavenly Bodies. This Illustrates That a Pound Does Not Weigh a Pound Everywhere In the Universe, But Changes According to the Mass and Density of the Heavenly Body upon Which It Is Placed.

THE earth is revolving around the sun in an orbit that is almost a perfect circle with a velocity of *eighteen and one-half miles per second.* If for any reason this orbital velocity should suddenly cease or be brought to *zero,* the earth would fall into the sun and the time of falling would be sixty-four and one-half days. If its orbital velocity should be brought *almost* to zero, that is if the earth still possest a slight motion at right angles to the line connecting it with the sun, it would describe an extremely narrow ellipse with the sun at the further focus (see diagram 1), and would return to the point where its velocity had changed after one hundred and twenty-nine days.

If the orbital velocity should be increased more and more, the ellipse would become wider and wider, and the period of the earth's revolution longer and longer. When the orbital velocity reached eighteen and one-half miles per second the earth would be revolving around the sun in a circular orbit in a period of 365¼ days (as it does now). If the orbital velocity should increase still more the earth's orbit would become elliptical again with the sun now at the nearer focus and the width of the ellipse would increase as the velocity increased.

THE EARTH COULD LEAVE SOLAR SYSTEM.

When the orbital velocity reached 26.2 miles per second (the velocity from infinity or parabolic velocity for the earth), the earth would escape the control of the sun and leave the solar system on the curve of a parabola never to return. If the orbital velocity should exceed 26.2 miles per second the earth would also escape from the solar system, but the curve would be hyperbolic instead of parabolic in form.

Now each planet in the solar system has its parabolic velocity or, as we might call it, velocity of escape from the solar system, and as this varies inversely as the square root of the planet's distance from the sun, it becomes less and less as the planet's distance from the sun increases.

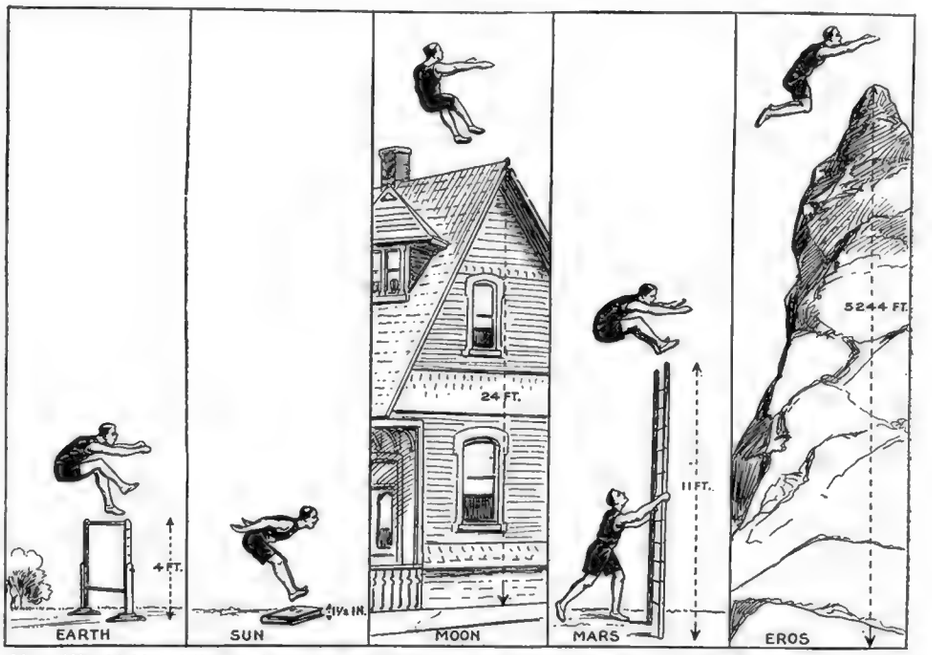
For Neptune the parabolic velocity is only 4.7 miles per second. If its orbital velocity of three and one-third miles per second should be increased to this parabolic velocity Neptune would escape from the solar system.

If a body should fall from infinity or the distance of the stars toward the sun under the force of the sun's attraction *alone,* it would have acquired a velocity of 4.7 miles per second by the time it had reached the orbit of Neptune, 26.2 miles per second when it had arrived at the earth's orbit and 383 miles per second by the time it had reached the surface of the sun.

Let us consider now what velocity an object at the surface of the sun must possess in order to escape the sun's attraction and pass off into space. Evidently this would be the same as the parabolic velocity or velocity from infinity for the sun's surface, 383 *miles per second.* Any object at the solar surface endowed with a velocity in excess of this amount would leave the sun never to return.

THROWING A STONE INTO INFINITY.

Since it can be shown that this velocity of escape varies directly as the square root of the mass of the attracting body, it is possible to compute the velocity of escape for objects on all of the planets in the solar system as well as for objects on the sun. These values are given in Table I. Objects on any of the planets possessing these velocities or greater velocities escape from the control of their respective planets and either become satellites of the sun or leave the solar system entirely, depending on the excess of their velocities over the critical value. It will be noted from a glance at these critical velocities given in Table I that it would be easily possible to fire a cannon ball from Ceres, the largest asteroid, that would pass off into space, never touching the surface of the asteroid, while on Eros a stone could be thrown from the hand with sufficient velocity to enable it to escape the control of the asteroid.



How Would You Like to Clear In One Bound a Mountain Nearly One Mile In Height? This Is Exactly What You Could Do If You Were on Eros, the Small Asteroid. If You Could Jump Four Feet High on Earth, You Could Jump Over One Mile on Eros. Even on the Moon You Could Jump Over a House Without Much Trouble, with One Bound.

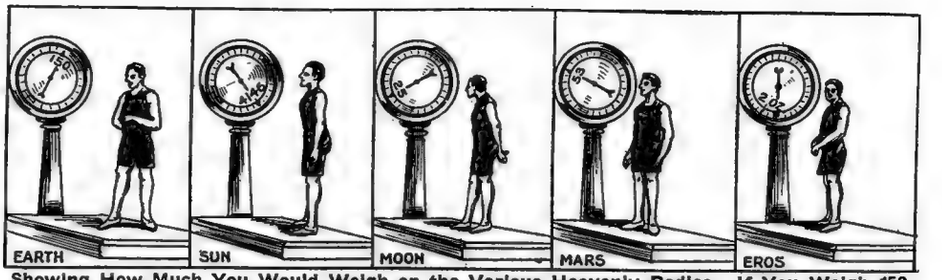
SHOOT A CANNON BALL FIVE MILES A SECOND AND YOU HAVE A NEW MOON.

In the last column in Table I is given the velocities for satellites grazing the surfaces of the various planets, the sun or moon, in circular orbits. It can be shown that these values are equal to the critical velocities or velocities of escape multiplied by the square root of one-half. It will be noted that for the sun this value is 271 *miles per second,* that is, an object hurled from the sun with a velocity of 271 miles per second would become a satellite of the sun, moving close to its surface in a circular orbit. An object hurled from the earth's surface with a velocity of 5 miles per second would likewise become a satellite of the earth, revolving around it in a circular orbit close to the surface.

It is interesting to consider in this connection what would be the course of projectiles hurled from the earth or other planets with varying velocities.

If an object should be thrown from a mountain or some other elevated position on the earth's surface *horizontally* (neglecting resistance of air) with a very slight initial velocity, it would fall almost straight downward, and if the earth were concentrated at a point at its center the object would move in a very narrow ellipse around the earth's center, returning to the point of departure again after 30 minutes. If the velocity is increased more and more the object falls further and further to one side, and if the earth were concentrated at its surface so the object would not encounter the surface; it would move in an elliptical path, always returning to the original point. The widths of the ellipse would increase with the velocity (see diagram II). Finally when the velocity with which the object is hurled reaches 5 miles per second it leaves the earth entirely and becomes a satellite of the earth, moving in a circular orbit with a period of 1 hour 25 minutes. If the velocity is increased beyond 5 miles per second the object continues to revolve around the earth in an elliptical orbit whose width increases with the velocity until a velocity of 7 miles per second is reached, when the object flies off on a parabolic curve, escaping the earth's attraction entirely and becoming a satellite of the sun. The same principle holds for all the other members of the solar system as well as for the earth, and a reference to table 1 will show the velocity of escape for each member of the solar system as well as the velocity with which an object must be thrown from the surface in order to make it a satellite of the planet in question.

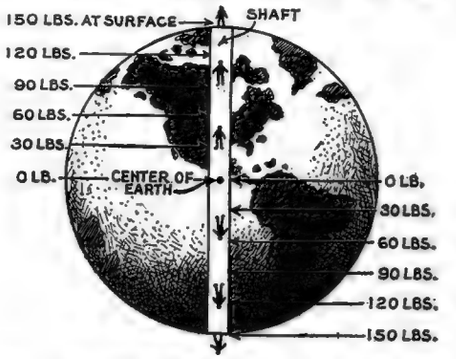
It is interesting to consider in this connection what would happen if the earth should suddenly explode. All particles that received an initial velocity *under seven miles per second,* the velocity of escape, would come back to the scene of the catastrophe *repeatedly* in elliptical orbits, and those that were ejected with *equal velocities* would come back *at the same time,* however different the directions of their ejection or the width of their orbits. If the velocity of ejection equaled or exceeded seven miles per second, they would not return.



Showing How Much You Would Weigh on the Various Heavenly Bodies. If You Weigh 150 Pounds on Earth, Your Weight Would Shrink to 2 Ounces on Eros. While on the Sun You Would Weigh over 2 Tons and You Would Not Have Sufficient Strength to Lift Your Own Body.

WEIGHT ON OTHER PLANETS.

Let us consider now some of the interesting phenomena arising from the fact that the surface gravity of a planet, or its attraction for objects at its surface, is proportional to its mass or the quantity of matter that it contains. This affects directly the weight of objects at the surfaces of the planets and the amount of work that can be performed against the attraction of gravity on the various planets.



Do You Know That If There Were a Shaft Drilled Right thru the Earth, and If You Were to Descend Into Same, You Would Weigh Nothing When You Arrived at the Center? Our Illustration Shows How Much You Would Weigh at the Different Levels in the Shaft.

Taking the earth's attraction for objects at its surface as the unit, the relative surface gravity for all other planets, the sun, and the moon, has been computed (see Table I) by multiplying the density by the radius, both quantities relative to the corresponding values for the earth.

We then find what a man weighing 150 lbs. on the earth would weigh if it were possible for him to exist on the sun, moon or other planets, to what height he could jump against the attraction of gravity and what weights he could lift; also with what velocity an object must be endowed to enable it to escape from the planet and under what condition it would become a satellite of the planet revolving close to its surface in a circular orbit.

We note (Table I) that a man who weighs 150 lbs. on the earth would weigh 4,146 lbs., or over *two tons,* on the sun. If he could jump to a height of four feet on the earth he would find himself unable to raise his body even two inches by his own energy, against the sun's surface gravity. He would be, indeed, crushed by his own weight, lifting his arms and feet and moving about only with the greatest effort. He would have as much difficulty in lifting a weight of seven pounds on the sun as in lifting a weight of two hundred pounds on the earth.

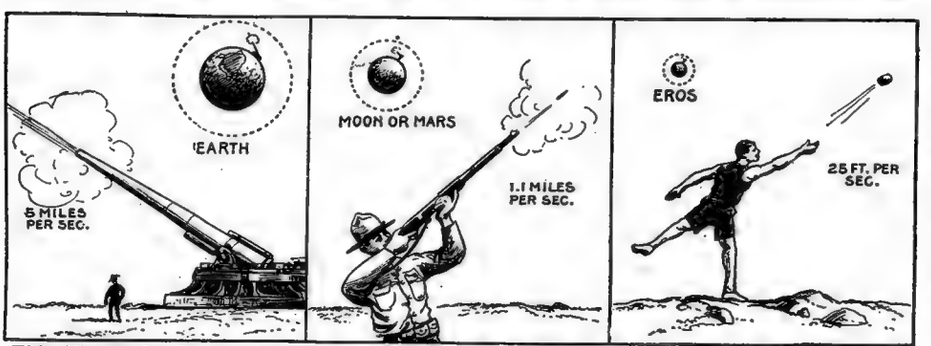
On the asteroid Eros on the contrary his weight would be but *two ounces.* He could jump to the height of a mile as easily as he could jump to a height of four feet on the earth, and he could lift *one hundred and thirty tons* as easily as he would lift two hundred pounds on the earth.

It will be noted that the weight of the large engine on the cover drawing is given as 684,000 pounds. This corresponds to a weight of 500 lbs. on Earth. This is probably the limit a professional strong man could lift on earth.

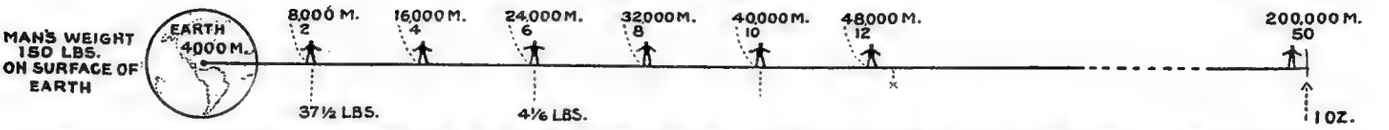
LIVING IN A VACUUM.

This brings us to the interesting subject as to what would happen if we were to visit one of our small planetary bodies on which there is no atmosphere, such as for instance our moon and any of the Asteroids. Being that the gravitational pull is so small on these bodies, the atmosphere—if they had any—probably escaped aeons ago. Consequently, if we were to visit any of these heavenly bodies, we would be placed in an absolute vacuum much greater than we can procure with our best vacuum pumps on earth. How, then, could we walk on such a body and exist? We must always remember that every square inch of our body on earth is weighed down with an atmospheric pressure of 14.7 pounds. The total pressure upon the human body is therefore enormous, amounting to 47,040 lbs. Remove this pressure and our blood vessels would burst like an automobile tire.

The thing to do then, if we are ever enabled to visit the moon or one of the Asteroids, would be to encase ourselves in a strong rubber fabric by having strips of thick rubber sheeting wrapt all around our body, as suggested in our cover drawing. These rubber strips would be wrapt around the body and limbs similar to what our soldiers do with their puttees. It would, of course, also be necessary that we should bring along our own air, and this, too, is suggested in our cover drawing, where a compressed air tank is strapt to the back of the man, an automatic air valve regulating the air supply as it is consumed. By means of suitable chemicals the air could be renewed automatically for an indefinite time. In order that we can see about us, it would also be necessary for us to provide a sort of helmet fitted with a thick glass plate adjusted air-tight to the helmet. The whole contrivance would then be strapt to the body.



This Illustration Depicts with What Force You Must Hurl a Body Into the Air so It Will Never Return,—in Other Words, Becoming a New Satellite. If You Could Build a Cannon to Shoot a Projectile Into the Air Going at the Rate of Five Miles per Second, It Would Become a New Moon Gravitating Around the Earth in an Orbit of Its Own. On Mars the Velocity Need Only Be 1.1 Miles per Second, While on Eros You Could Throw a Stone Into the Air So That It Would Never Return.



Suppose You Were to Rise Above the Surface of the Earth in Some New Space-Flying Machine. This chart Shows How Much Weight You Would Lose as You Get Away from the Gravitational Attraction of the Earth.

The feet as well as the hands would also have to be encased in very snug-fitting rubber, as no part of the human body should be exposed to the vacuum which would draw out the blood immediately. It is well known that when aviators ascend to a great height blood begins to flow out from underneath the finger nails, due to the reduced pressure. It can be easily imagined what will happen if all the pressure was removed and the hand was exposed to the vacuum.

His greatest difficulty, granted he were able to withstand the lack of air and atmospheric pressure, would be experienced in retaining a foothold upon this insecure mass of rock spinning thru space, for so slight is the attractive force that holds him to the surface that *it would be possible for him to jump with sufficient initial velocity to escape from the asteroid,* the velocity of escape being only thirty-six feet per second, and the height to which he is able to jump against the force of gravity being 1 mile.

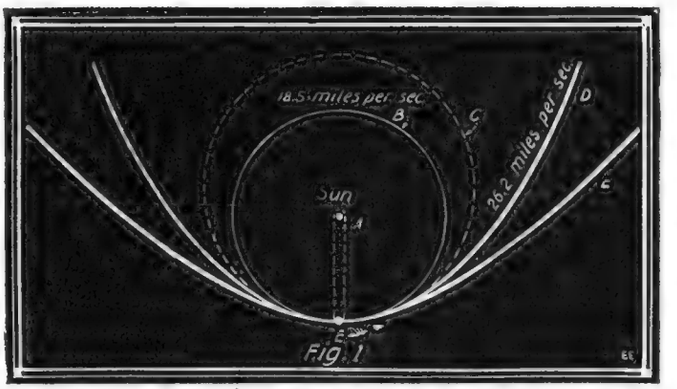
Referring to Table I, we note that the surface gravity of Uranus is nearest to that of the earth and that a man who weighs 150 lbs. on the earth would weigh 149 lbs. on Uranus and would be able to do practically the same amount of work. This arises from the fact that the greatly *increased radius* of Uranus, three and eight-tenths that of the earth, is offset by its greatly *decreased density,* which is only one-quarter that of the earth, the product of the two giving the surface quantity of Uranus. This is also true in a less degree with Saturn and Neptune. The huge bulk of Jupiter, however, considerably overbalances its low density, and a man who weighs 150 lbs. on the earth would find his weight of 378 lbs. a burden to him on Jupiter.

MAN WEIGHS 53 POUNDS ON MARS.

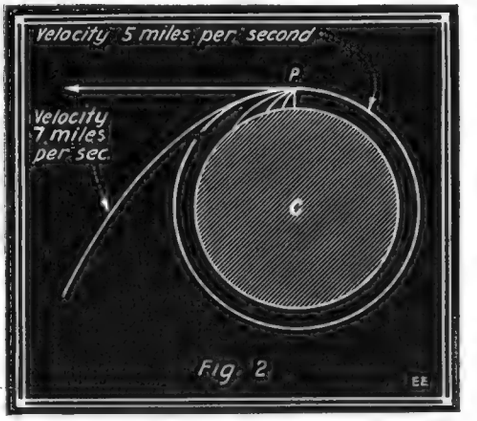
On Mars, on the other hand, he would find he weighed only 53 lbs. and that he could jump nearly three times as high as he could on the earth and lift loads nearly three times as heavy. On the moon he would weigh only one-sixth as much as on the earth and could throw a ball six times as far and jump six times as high. He would lift six hundred pounds as readily as he would lift one hundred pounds on the earth.

Venus most closely resembles the earth among the terrestrial planets and a man would find, if he were suddenly transferred to Venus, that he would only lose twenty-two pounds in weight by the change. He could lift weights fifteen per cent heavier and jump fifteen per cent. higher than on the earth.

Let us note in passing the low velocity of escape for the moon, Mercury and Mars. This is believed to have an important bearing upon the possibility of these bodies possessing and holding atmospheres. The molecules of gases in the atmosphere are moving in all directions at high velocities. It has been computed that the molecular velocity of oxygen is 1.8 miles per second at zero centigrade, of nitrogen 2.0 miles per second, of water vapor 2.5 miles per second, of helium 5.2 miles per second and of hydrogen 7.4 miles per second. Evidently then the earth could not *permanently* hold free hydrogen in its atmosphere or the moon and Mars any of these gases. Even if Mars were originally clothed with an extensive atmosphere it is, according to the kinetic theory of gases, losing it molecule by molecule. Moreover, in inter-planetary space there must be wandering molecules of gases that have deserted the bodies in the solar system that have low velocities of escape. Of course upon even the largest asteroids there could not be any of the atmospheric gases of the earth, as the velocity of escape is so excessively low for all of these bodies.



This Illustrates What Would Happen If the Earth's Orbital Velocity, 18.5 Miles per Second, Were to Change Suddenly. A, If the Velocity Would Almost Cease. B, Present Velocity of Earth. C, Velocity Greater Than 18.5 Miles per Second. D, Velocity 26.2 Miles per Second. E, Velocity Greater Than 26.2 Miles per Second. At This Speed the Earth Leaves the Solar System Never to Return.



To Illustrate Course of Projectiles Hurled Horizontally from P, a Point on the Earth's Surface (Neglecting Friction of Air) at Different Velocities in Direction of Arrow. If Velocity Is Less Than 7 Miles per Second, Projectile Moves in Elliptical Curve Whose Width Depends Directly on Initial Velocity with Which Projectile Is Hurled. If Velocity Equals 7 Miles per Second, Projectile Becomes a Satellite of the Planet, and if Velocity Is 7 Miles per Second or Greater, the Projectile Escapes Earth's Attraction and Goes Off into Space.

WEIGHT INSIDE OF EARTH.

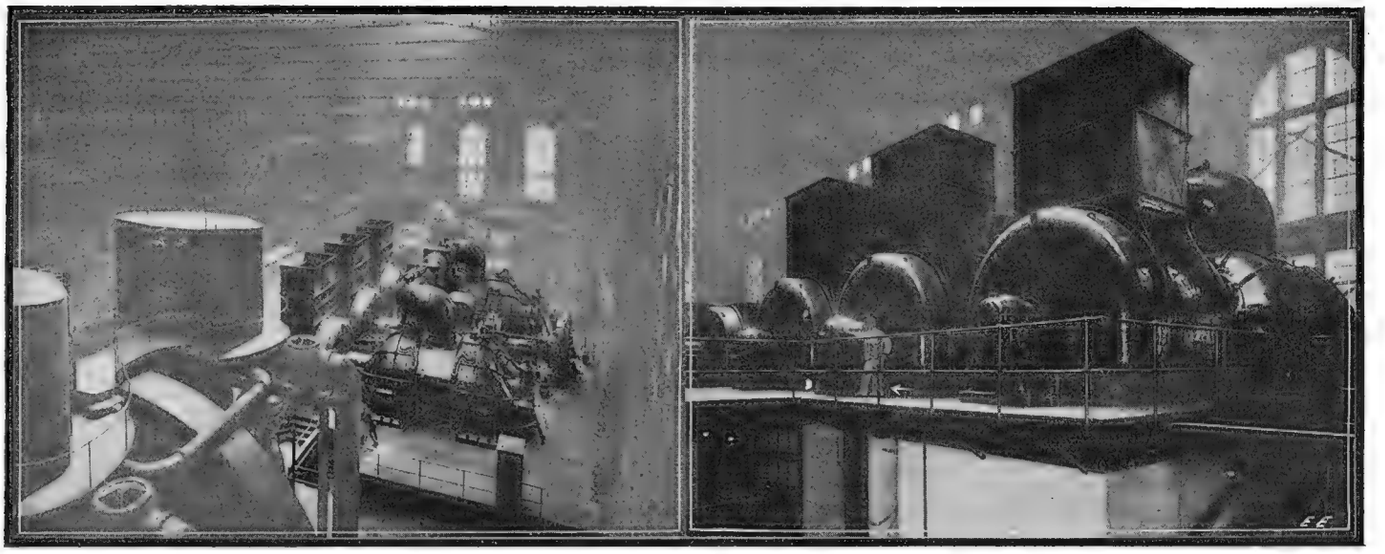
Let us consider now, in concluding, what would be the effect upon a man's weight if he should fall toward the earth's center thru a circular shaft (see diagram III), assuming that the earth's density is uniform thruout. Since surface gravity is equal to the density times the radius, his weight at the surface will be decreased as he falls toward the center proportionally directly to his *distance below the surface.* At a distance below the surface equal to one-fifth of the radius his weight will be decreased one-fifth of the value for the surface, that is a man who weighs 150 lbs. on the surface would weigh 120 lbs. one-fifth of the distance to the center or eight hundred miles below the surface. Two thousand miles below the surface or one-half the distance to the center his weight would be one-half the surface value or seventy-five pounds and *at the earth's center*

(*Continued on page* 449)

TABLE I.

	Diameter (In Miles)	Density (Relative to Earth's)	Radius (Relative to Earth's)	Surface Gravity (Relative to Earth's)	Man's Weight in Pounds	Height Man can Jump	Weight Man can Lift	Velocity of Escape	Velocity with which object must be projected to become a satellite moving close to surface in perfect circle
Earth.....	7,918	1.00	1.00	1.00	150 lbs.	4 feet	200 lbs.	7 mi. per sec.	5 mi. per sec.
Sun.....	864,392	.25	109.17	27.64	4,146 "	1.7 in.	7 "	383 "	271 "
Moon.....	2,160	.60	.27	.16	25 "	24 feet	1,214 "	1.5 "	1.1 "
Mercury.....	3,009	.81	.38	.31	46 "	13 "	650 "	2.2 "	1.6 "
Venus.....	7,701	.88	.97	.85	128 "	5 "	234 "	6.6 "	4.7 "
Mars.....	4,339	.65	.55	.35	53 "	11 "	564 "	1.5 "	1.1 "
Jupiter.....	88,392	.23	11.16	2.52	378 "	1.6 "	79 "	37 "	26 "
Saturn.....	74,163	.11	9.37	1.07	160 "	3.75 "	187 "	22 "	16 "
Uranus.....	30,193	.26	3.81	.99	149 "	4.0 "	201 "	13 "	9 "
Neptune.....	34,823	.20	4.40	.87	130 "	4.6 "	231 "	14 "	10 "
Ceres (largest asteroid)...	485	.60	.0606	.036	6 "	108 "	5,406 "	1736 ft. per sec.	1228 ft. per sec.
Eros (small asteroid)...	10	.60	.00126	.00076	2 oz.	5,244 feet (almost 1 mile)	262,200 " (130 tons)	36 " (*See Note*)	25 "

Note:—Objects leaving surface with velocity greater than values given here would not return.
Note:—The surface gravity is the product of the planet's density by its radius (relative to corresponding values for the earth's), that is, Col. 4 is the product of Col. 2 and Col. 3.



New York City Can Now Boast of the Largest Steam Turbine-Dynamo Generating Unit in the World—100,000 Throbbing Horse-Power. It Comprises a Triplex Turbo-Alternator, Occupying About One-Fourth the Space of the Old-Type Reciprocating Engine Shown at the Extreme Left of the Photo Herewith. The Comparative Size of the 100,000 H.P. Turbine Unit May Be Judged by the Man Standing Beside It—See Arrows. The Old Reciprocating Steam Engine Towered 75 feet into the Air; the New Turbine-Dynamo Stands But 20 Feet in Height. The Current Delivered Is Three Phase, 25 Cycle Frequency, at a Potential of 11,000 Volts.

World's Biggest Turbine-Dynamo--100,000 H. P.

By WILLIAM H. EASTON

TO her already long list of "greatest things in the world," New York City can now add another item, for the Interborough Rapid Transit Company has recently placed in operation at its 74th Street power house a triplex turbine-generator that is as superior to its rivals in power as the Woolworth Building is in height or the arch of the Hell Gate Bridge in length of span.

One hundred thousand horsepower is the amount of power this great engine can develop when pushed to its maximum. It is difficult to find an example that will convey an adequate impression of this figure, but the following may be of some assistance. Suppose our army now abroad, which consists of about a million men, has been landed over night and is marching up Fifth Avenue. Visualize the parades you have seen and then realize that it will take over three days and nights for this particular one, moving steadily forward in regular formation, to pass thru the Arch of Victory. Now, in a contest of strength between the turbine and all of these men taken together, the turbine would probably win.

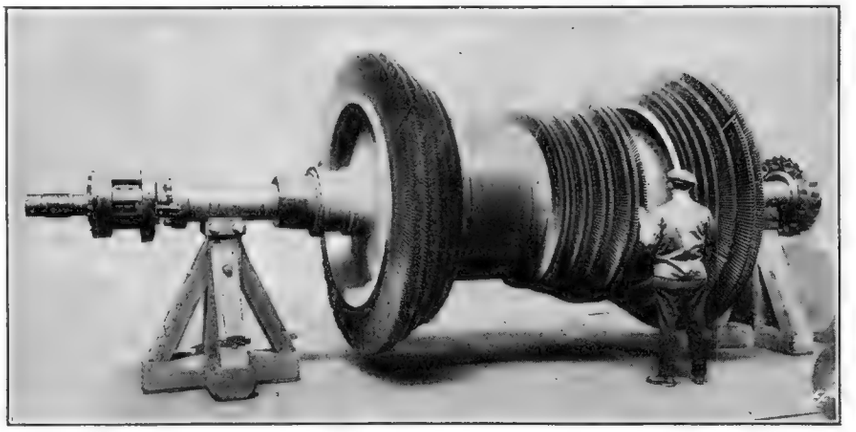
How the Turbine Operates.

The visitor, journeying to 74th Street to see this great turbine, will probably be disappointed in its appearance. It has, indeed, a massiveness that speaks of immense power within, but in size it is dwarft by the old vertical reciprocating engine, of one-twelfth its capacity, beside which it stands; and in addition, since all its working parts are enclosed, it is entirely lacking in the fascination that visual movement imparts. But its deficiencies as a spectacle are real virtues in the eyes of the engineer, for they mean lower first cost, smaller space occupied, reduced installation and operating charges, and a high degree of reliability.

The very conspicuous difference in size between the turbine and the reciprocating engine is due to their different operating principles. The reciprocating engine consists essentially of a cylinder in which a piston is pushed up and down by the steam. The main parts of the turbine, however, are a spindle, carrying hundreds of small vanes, and a casing which encloses the spindle. The steam acting upon the vanes of the spindle revolves it as the wind turns a windmill. The motion of the turbine is, therefore, rotary and as there are no heavy parts to be stopt and started at the end of every stroke, as there are in a reciprocating engine, very high speeds are permissible, thus making it possible to develop great power from a comparatively small machine. The speed of this particular turbine is 1,500 revolutions a minute.

As has been said, the turbine is triplex; that is, it consists of one *high pressure* element and two *low pressure* elements, each connected to a separate electric generator. This gives it the appearance of three distinct machines, but it is actually a *single unit* and all three elements are started and controlled as one. The triplex arrangement is employed because it is mechanically greatly superior to the single element design for a machine of such great power. There is also the very decided additional advantage that, in an emergency, any one or two of the elements can be shut down without stopping the others. All the power eggs are, therefore, not in one basket, and the high efficiency of a single large ma-

(*Continued on page* 453)



A Close View of the Rotating Blades or "Rotor" of One of the Steam Turbines Comprising the Triplex 100,000 Horse-Power Generating Unit Recently Installed for the Interborough Rapid Transit Company, New York City, at its 74th Street Power House. Almost Beyond Conception Is the Delicacy and Accuracy of Balance of This Wonderful Blading. It requires the Highest Degree of Workmanship to Build Such a Rotating Mass, Which Shall Be Perfectly Balanced When Revolving at 1,500 Revolutions per Minute.

The Rotor Member Here Shown Is Driven Around by High Pressure Steam Flowing Thru the Rows of Blading. A reaction Force Is Set up Owing to the Steam Passing First Between Stationary Blades and Then Thru a Set of Rotor Blades, Etc., Etc., Repeatedly. There Are Two Low Pressure and One High Pressure Stages In This Triplex Turbine Unit. The Steam Enters the High Pressure Chamber First, Then Expanding, It Passes Into the Low Pressure Elements, Thence Passing to the Giant Condensers.

Wide World Photos

An Exceptionally Fine Picture of the Giant British Dirigible—the R-34 Descending Toward the Landing Field at Mineola, L. I., N. Y. The Engines Are Kept Running While Descending, and the Rudders Altered to Steer the Ship Up or Down.

How the R-34 Crost the Atlantic

Details of the Giant 2,000,000 Cu. Ft. Trans-Atlantic Blimp

THE plucky English fliers succeeded in flying across the Atlantic Ocean, a course extending over 3,000 miles, in a gas bag known variously as a dirigible and blimp, and finally as her commander termed her, a "filleted rigid," meaning a rigid or framed gas filled balloon, having filleted or flat segmented sides. After making a successful landing at Mineola, L. I., N. Y., she sailed away on her return to England and landed there after a record-breaking voyage of 75 hours.

At Mineola the R-34 was hauled down and held by powerful cables, a large force of several hundred enlisted men being required to watch her day and night, in the event of wind gusts, storms, change of buoyancy due to the heat of the sun expanding the gas with which she was filled, and a hundred and one other expected but uncertain capers which the gigantic 670-foot "blimp" might cut up.

Some idea of her great bulk can be ascertained from the accompanying semi-sectional view of her, which shows the steering, eating and sleeping quarters, as well as many other interesting features.

LANDING TOWERS FOR DIRIGIBLES.

On her successful return to England the great airship was "anchored" to a new device designated by British Air Force engineers a "landing tower." Several of these towers are now in use in England for "anchoring" these giant lighter-than-air machines. They are provided with elevators to bring the crew and passengers to earth. The airship is held by the "nose" in such a manner as to ride a storm much more safely than if held to the ground. Such a device was described and illustrated in the July issue of this magazine.

Automatic landing and mooring are essential before airships can be put up as a commercial proposition.

Three points are being studied by the British technical departments now. One is moving the airship in the open, the second is the economy of man power required in landing, and the third the necessity for a good reserve of speed. This last is not a question of petrol supply, but of horsepower and the size of the ship.

A recent trial trip of the R-32 gave from 67 to 70 miles an hour, and she has 1,550,000 cubic feet capacity.

The R-34 has 2,000,000, and on her Atlantic trip reached approximately 60 miles an hour, but this is not going to be the speed of the future airship.

Major Scott, before he sailed, said he had no doubt that 100 miles an hour with proportionate "dispersal" lift, which is 50 per cent of the actual lift, would be obtained from airships that would be built with a capacity of 5,000,000 cubic feet.

Unless the size of the airship is increased, engines for this higher speed cannot be fitted, so that the experiments which the Admiralty is going to carry out will be vital to the commercial interests of the future.

Some idea of the wonderful aerial engineering features incorporated in the R-34, the first blimp to cross the Atlantic Ocean, can be gained from the following excellent description by Capt. Samuel T. Moore, commander of the balloon troop helping care for the transatlantic airship.

The forward gondola is the navigator's office and it is from this that the ship is controlled thru speaking tubes, electric bells and signals. The steering gear is also controlled from this gondola, as well as the rudder. On the side of this cabin are "elevator wheels" which control the elevators for changing the altitude when necessary. There is a table in the navigator's office on which charts are made while a flight is in progress. Many scientific instruments are on it, as well as the controller for the radio station. There is an engine in it, and immediately behind it are two more engines on either side. One or two of these engines work while the other sleeps. All the engines on the ship could be kept working if it were necessary, but as a general rule one of them is stopt and cleaned while the dirigible is in operation.

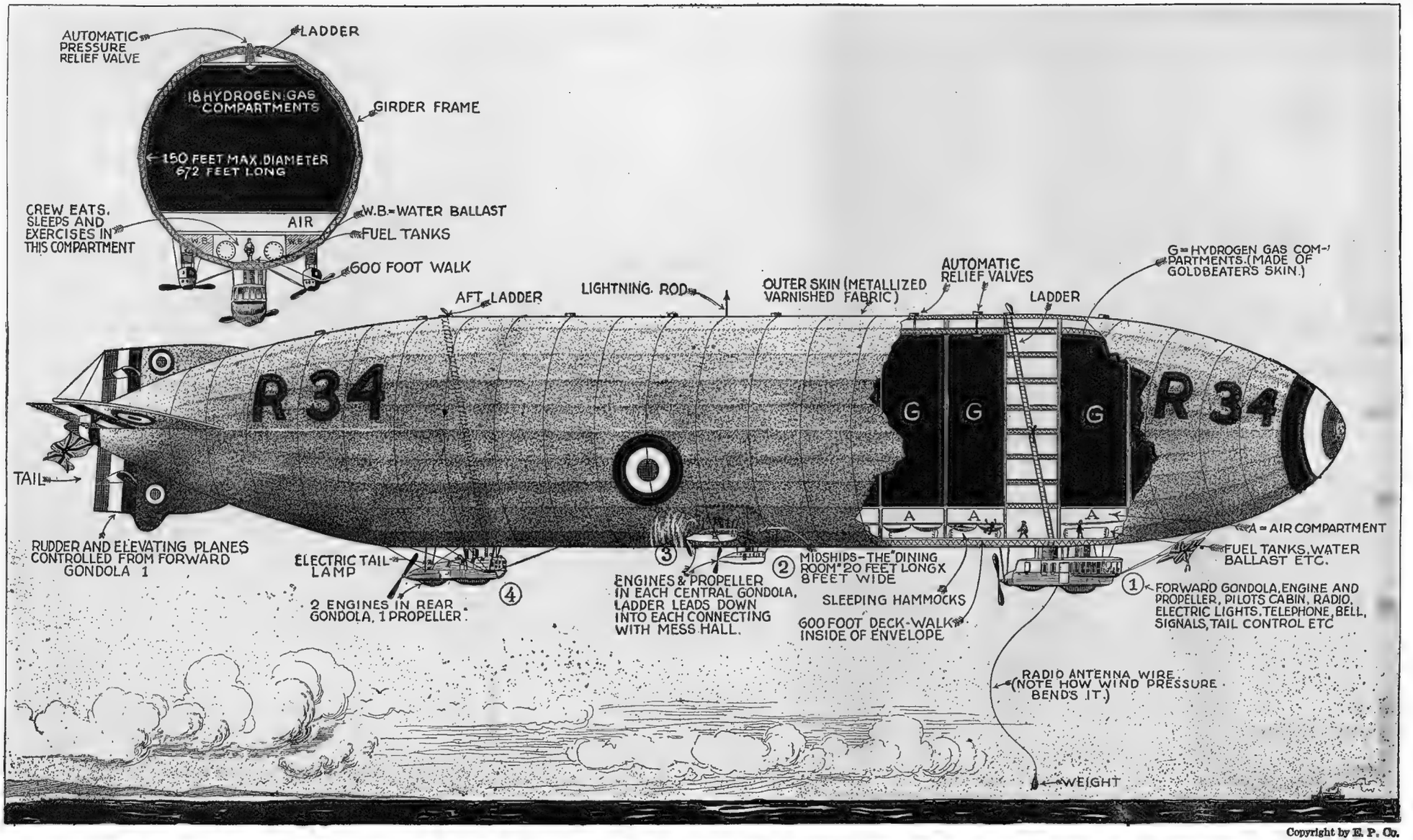
In the aft gondola are two more engines, making five in all—one in bow, two amidship and two at the stern. There are, however, only four propellers, the two engines at the stern having only one propeller. Two men are at work at the engines during the flight, one man operating and the other oiling.

DECK WALK 600 FEET LONG.

Inside the huge envelope there is a deck just 600 feet long and very narrow, covered with linoleum. It is not difficult for a man to balance himself as he walks along this deck, but it would be difficult for two men to walk it.

There are eighteen hydrogen gas compartments inside the shell, as shown in the semi-sectional view herewith. Nine of them have automatic valves, while the other nine are equipt with hand valves. The pressure of the hydrogen is not constant, but varies according to atmospheric conditions, with heat causing an expansion and cold contraction. This is regulated by the valves. If

(*Continued on page* 404)


AUTOMATIC PRESSURE RELIEF VALVE
LADDER
18 HYDROGEN GAS COMPARTMENTS
GIRDER FRAME
150 FEET MAX. DIAMETER
672 FEET LONG
CREW EATS, SLEEPS AND EXERCISES IN THIS COMPARTMENT
AIR
W.B.=WATER BALLAST
FUEL TANKS
600 FOOT WALK
AFT LADDER
LIGHTNING ROD
OUTER SKIN (METALLIZED VARNISHED FABRIC)
AUTOMATIC RELIEF VALVES
LADDER
G=HYDROGEN GAS COMPARTMENTS. (MADE OF GOLDBEATERS SKIN.)
R 34
G G G
R 34
TAIL
A A A
A = AIR COMPARTMENT
RUDDER AND ELEVATING PLANES CONTROLLED FROM FORWARD GONDOLA 1
ELECTRIC TAIL LAMP
3
2
MIDSHIPS-THE DINING ROOM 20 FEET LONG X 8 FEET WIDE
FUEL TANKS, WATER BALLAST ETC.
1
FORWARD GONDOLA, ENGINE AND PROPELLER, PILOTS CABIN, RADIO, ELECTRIC LIGHTS, TELEPHONE, BELL, SIGNALS, TAIL CONTROL ETC
4
2 ENGINES IN REAR GONDOLA, 1 PROPELLER.
ENGINES & PROPELLER IN EACH CENTRAL GONDOLA, LADDER LEADS DOWN INTO EACH CONNECTING WITH MESS HALL.
SLEEPING HAMMOCKS
600 FOOT DECK-WALK INSIDE OF ENVELOPE
RADIO ANTENNA WIRE. (NOTE HOW WIND PRESSURE BENDS IT.)
WEIGHT

Copyright by E. P. Co.

THE "INSIDES" OF THE TRANS-OCEANIC AIRSHIP—THE R-34. THE FIRST DIRIGIBLE TO FLY ACROSS THE ATLANTIC

Imagine a gigantic airship resembling a huge sausage floating lazily thru the air over your head. This wonderful invention of man, measuring 672 feet in length, is nearly as high as the fifty-five story Woolworth Building in New York City, or three-quarters as high as the Eiffel Tower. The giant British airship, which successfully made the trip across the Atlantic Ocean from England to Mineola, L. I., N. Y., and return, was piloted by Major G. H. Scott and a crew of thirty men. On the trip over from England to America, her commander unconsciously carried a stowaway, a former mechanic who had worked on the ship in England, and who would not be cheated out of the first trans-Atlantic trip. The ship also carried a tabby cat as a mascot. The English Government has plans under way to build several new dirigible gas-filled airships similar to the R-34, but about twice its size. The R-34 carried approximately 2,000,000 cubic feet of gas. The accompanying illustration shows comprehensively some of the novel features in this first "Leviathan of the Air". The crew dined, slept and exercised in the long compartment running along the lower side of the gas envelope. The dining room is placed amidships, and is 20 feet long by 8 feet wide. All the four suspended gondolas carried propellers and petrol motors for operating them, and the members of the crew had access to any of the gondolas as occasion required, by means of covered ladders leading down from the 600-foot walk and passageway at the base of the gas envelope. The crew slept in hammocks suspended from the framework of the envelope just above the 600-foot walk, as shown in the diagram. In rising from the ground at the start, ships of the R-34 class do not operate their engines, but simply throw off their mooring cables, when they rise rapidly to a considerable height,—8,000 to 9,000 feet elevation. The big ship then finds her natural "equilibrium" point, and the commander gives the order to start the engines and propellers. The giant blimp, termed a "filleted rigid" by her commander, Major G. H. Scott, then comes under perfect control. To cause the ship to descend, is simply a matter of shifting the water ballast and raising or lowering the horizontal tail rudders. The ship is kept on an even keel by vertical tail rudders. Astronomical observations, such as "shooting the sun" with a sextant, are carried on by one of the officers, who climbs up an 80-foot ladder to the top of the airship, there being two of these ladders, fore and aft. The range of the special wireless apparatus is remarkable, signals having been transmitted from the R-34, 1200 miles, from off the Azores to England. Signals from England and America were copied in mid-ocean. Four distinct wireless sets were carried, including one "wireless telephone" set. The Dirigible has a much greater lifting capacity than the NC planes, and can not only carry a higher powered radio set, but can support a longer antenna when desired.

Left: W. J. Edwards, Wireless Operator of the R-34 and "Jazz," the Cat Mascot. Taken at Mineola Immediately After the Huge Craft Terminated Its 108 Hour Trans-Atlantic Journey There From Scotland. Center: Close-Up Showing Construction of the "Gondola" of the British R-34 Rigid Dirigible. Note Ladder Leading From Compartment to Gasbag, Thru Which Passageway Connects With Other Gondolas. Right: Photo Taken In Chart Room of R-34 While It Was In Mid-Atlantic, Showing Radio Operator Talking With Two Continents.

Copyright by Underwood & Underwood, N. Y.

the valves should get stuck, something might happen. They have a manometer by which they read the pressure in the hydrogen tanks Ten millimeters is dangerous. Should the valves refuse to work a fire might start and the crew be forced to land or leap for life.

EIGHTEEN HYDROGEN TANKS

The eighteen hydrogen tanks are made of goldbeaters' skin, which is the intestines of calves. The final inflation—that is, the loading of petrol and hydrogen—takes place at the minimum temperature after the sun goes down. Flying over a warm city causes expansion, and over the sea, where it is cold, the bag is caused to contract. On the way over, while flying over the ice floes around Newfoundland, there was a contraction of 40 per cent.

When the machine starts to rise and the guy ropes are thrown off, she rises until she finds her equilibrium. It may be 500 and then it may be 3,000 feet. When she finds her equilibrium, the motors start. Meanwhile the wind carries her wherever it pleases. That is the reason why in most cases a start is made between midnight and dawn.

There are eighty-one tanks on board which contain petrol, and weigh approximately 500 pounds each. The capacity of each is seventy gallons. Sixteen of these tanks are fixed to the framework. The others are called "slip-tanks," and have double functions, acting at times as ballast. The water ballast is carried in canvas containers. There are eight emergency containers—that is, four forward and four aft. The water is put in these emergency bags in accordance with the atmospheric conditions. They carry ballast weighing from 500 to 3,000 pounds.

There are three tanks of drinking water and one reserve tank containing distilled water, used in case of a shortage of drinking water. On the way over, the men were limited to a pint of water a day toward the end of the journey.

EATING AND SLEEPING QUARTERS.

The dining room is in the center of the ship, the only place where the deck is wide. It is about twenty feet long and eight feet wide. There are three tables on hinges fastened to the framework, the same as on ocean liners. Of course the officers and men use the same dining room. The food is already prepared but the men could cook if they wanted to by means of an electric stove in a gondola. They have to stand while they eat. The pantry is small, approximately two by four by eight.

The sleeping quarters are not very comfortable. The men sleep in light hammocks suspended from the framework. There are about ten hammocks, which are woven from Italian hemp. There is not much feeling of stability. If a man fell out of one, he would fall thru the fabric and out into the clouds. One cannot get a good, deep, untroubled slumber.

At the extreme end of the envelope there are no gas compartments—that is, for about twenty-five feet from the bow and from the tail there is vacant space. There are only two stationary electric lights inside the envelope, making it necessary for the men to carry electric flashlights.

The cockpits fore and aft are equipt with heliographs. The observer is not comfortable. He is compelled to stand upon an aluminum ladder with his head above the ship. The extra clothes carried by the crew are strapt to the side of the envelope. The crew of the R-34 brought only their dress uniforms with them on their voyage as extra clothing.

PARACHUTES FOR CREW.

Running along the deck inside the envelope are the parachutes and life-belts. These appliances are kept in canvas containers. The life-belts are inflated with air. They go around the chest, and when wrapt up look like a bundle of clothes. Both the parachutes and life-belts are always available. If overland the men were forced to leave the ship, the parachutes might save them, while if over the sea the parachutes and life-belts would both be used and might possibly save them.

It is not comfortable on the ship at all. The static electricity in the air might cause a fire and explosion. For this reason the men wear rubber slippers, sometimes cloth, for fear that the sparks from the nails in leather shoes might start a fire. The lightning rod is a piece of steel cable with a tassel on the end.

THE RADIO EQUIPMENT.

The R-34 is probably the largest of the lighter-than-air machines. It is exclusively of British design and construction, and is navigated entirely by the navigation officer from the forward gondola. This officer works from a bridge, much the same as the bridges on trans-Atlantic steamers, and controls the airship. In back of the navigation officer's headquarters is the "Wireless Room" fitted with four wireless sending and receiving outfits, the range of these varying considerably.

Lieut. R. F. Durrant of the *Royal Air Force* claims the following ranges for his Radio apparata: With a three-step ampli-

(*Continued on page* 438)

To the Editor of the Electrical Experimenter:

I regret that owing to circumstances beyond my control it was deemed advisable to postpone the publication of the article which I had intended for your August number. But the objections to its appearance will be shortly removed and I shall be pleased to forward it in due course for embodiment in your October issue.

Irrespective of this, I think it well on this occasion to notify your readers, as a precaution, that I am not one of those who display the sign "Do it now" on their desks and office doors. My motto is "Do not do it now. Think it over".

Very truly yours,

N. TESLA.

Under-Water Surveying by Reflected Sound Waves

By H. WINFIELD SECOR

ASSOCIATE MEMBER AMERICAN INSTITUTE ELECTRICAL ENGINEERS

LOCATING invisible objects at distances of several miles under water is not such a new scientific fact, as several schemes for carrying out the detection of submarines by these sound waves, radiated from the propeller and engine of the undersea craft, were conceived and applied more or less successfully during the progress of the World War, and enemy submarines were trailed by means of submerged microphones or electrical sound detectors. But it has not been possible heretofore to utilize ordinary apparatus, such as a *single* sound detecting instrument located at a *single* point, to *accurately locate any object at an appreciable distance to within a few feet.* However, a New York inventor and electrical engineer, Mr. E. E. Ries, has been working for a number of years on a most ingenious *reflected-sound* scheme for locating various objects such as submarines, icebergs, charting ocean and river beds, etc., and the present article deals with the remarkable principle of sound wave triangulation, as evolved and perfected by Mr. Ries.

Our readers may probably remember having read several years ago of an "iceberg detector" operating on the sound wave principle, devised by Mr. Ries, in which two sensitive microphones fitted with horns were mounted at the extreme ends of a yardarm high up on the mast of a ship. To locate the distant iceberg, even in a fog or at night as well as day-time, a powerful siren placed exactly midway between the

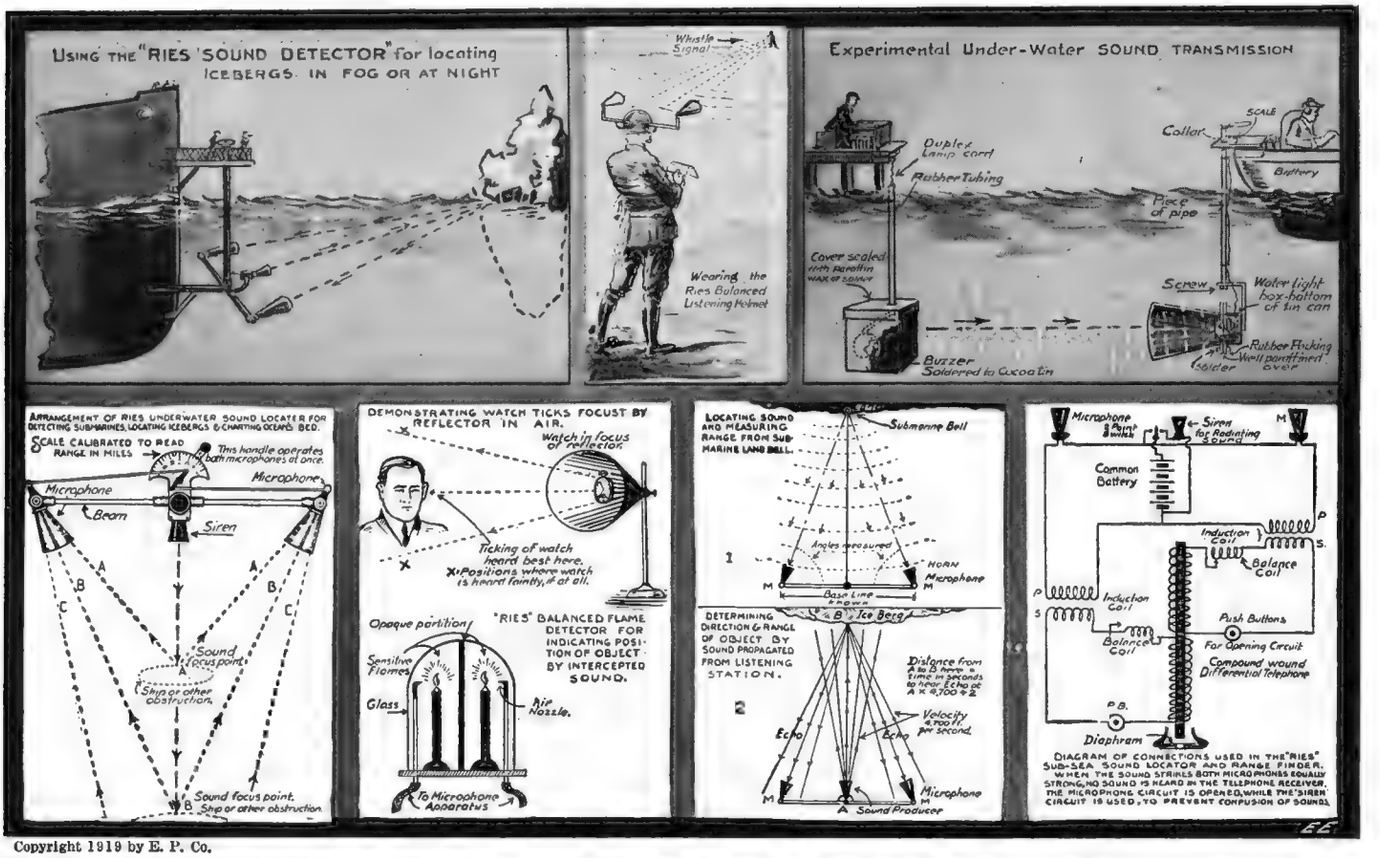
The Ries Under-water Sound Detector and How it Works.

microphones on the yardarm or spar, was sounded. The yardarm carrying the microphones was then swung on the mast as an axis, until the "echo" reflected from the iceberg was picked up several seconds later in the microphones. By a special scale device attached to the pivoted microphone elements, the angles which they subtended when both were focust on the spot from which the echo rebounded, showed the distance in feet or yards, as the case might be.

Before going further into the details of Mr. Ries's most ingenious and promising system of "Subaqueous Surveying" by means of reflected sound waves, it will prove interesting to look into some of the principles of sound wave physics underlying the functioning of this latest scientific achievement. Moreover, as Mr. Ries pointed out, his system of sound wave triangulation overcomes all the weaknesses of the single, straight-line sound detectors, by utilizing a greater base line in his triangular determination of the source of the sound or echo, and by this means he confidently believes that ships, submarines, icebergs or other obstructions, including the depth, contour and nature of the ocean bed or rocky coast, *can be located quickly and precisely to within a few feet, even at a distance of eight to ten miles or more.* This seems all the more probable when the wonderful principle on which his system operates is more fully understood.

SOUND WAVES IN AIR AND WATER.

In the original scheme for locating icebergs or other objects projecting above the water, as devised by Mr. Ries some years ago, the propagation and reflection of


USING THE "RIES" SOUND DETECTOR for locating ICEBERGS IN FOG OR AT NIGHT
Whistle Signal
Wearing the Ries Balanced Listening Helmet
Experimental Under-Water SOUND TRANSMISSION
Duplex Lamp cord
Rubber Tubing
Collar
SCALE
Battery
Piece of pipe
Cover sealed with paraffin WAX or solder
Screw
Water tight box-bottom of tin can
Buzzer Soldered to Cocoa tin
Rubber Packing
Well paraffined cover
ARRANGEMENT OF RIES UNDERWATER SOUND LOCATER FOR DETECTING SUBMARINES, LOCATING ICEBERGS & CHARTING OCEAN BED.
SCALE CALIBRATED TO READ RANGE IN MILES
This handle operates both microphones at once.
Microphone
Microphone
Beam
Siren
Sound focus point.
Ship or other obstruction.
Sound focus point.
Ship or other obstruction.
DEMONSTRATING WATCH TICKS FOCUST BY REFLECTOR IN AIR.
Watch in focus of reflector.
Ticking of watch heard best here.
X-Positions where watch is heard faintly, if at all.
Opaque partition
Sensitive Flames
Glass
Air Nozzle.
"RIES" BALANCED FLAME DETECTOR FOR INDICATING POSITION OF OBJECT BY INTERCEPTED SOUND.
To Microphone Apparatus
LOCATING SOUND AND MEASURING RANGE FROM SUBMARINE LAND BELL.
Submarine Bell
Angles measured
HORN
Microphone
Base Line known
DETERMINING DIRECTION & RANGE OF OBJECT BY SOUND PROPAGATED FROM LISTENING STATION.
Ice Berg
Distance from A to B here in time in seconds to hear Echo at A = 4,700 ± 2
Velocity 4,700 ft. per second.
Echo
Echo
Microphone
Sound Producer
Microphone
Siren for Radiating Sound
Common Battery
Induction Coil
Balance Coil
Induction Coil
Balance Coil
Push Buttons For Opening Circuit
Compound wound Differential Telephone
P.B.
Diaphram
DIAGRAM OF CONNECTIONS USED IN THE "RIES" SUB-SEA SOUND LOCATOR AND RANGE FINDER. WHEN THE SOUND STRIKES BOTH MICROPHONES EQUALLY STRONG, NO SOUND IS HEARD IN THE TELEPHONE RECEIVER. THE MICROPHONE CIRCUIT IS OPENED, WHILE THE "SIREN" CIRCUIT IS USED, TO PREVENT CONFUSION OF SOUNDS.

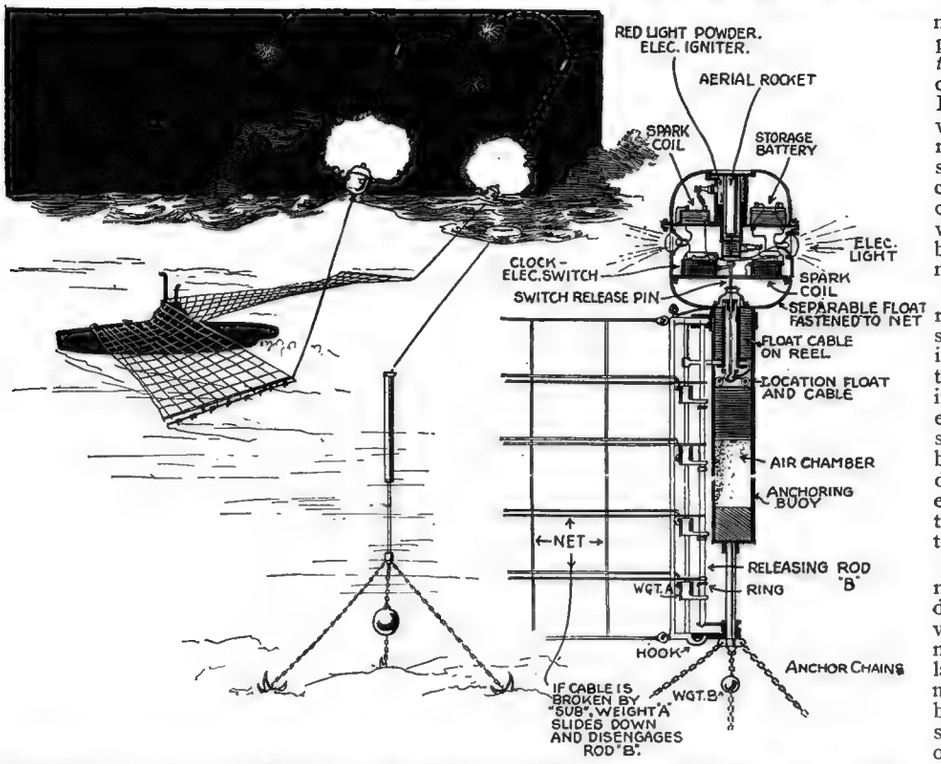
Copyright 1919 by E. P. Co.

The "Ries" Improved Under-Water Surveying and Locating Scheme, Utilizing Reflected Sound Waves Propagated thru the Water, Promises to Solve Many of Our Greatest Problems. Among These We Find the Locating of Sunken Ships, the Charting of River and Harbor Beds, Detecting and Locating of Enemy Submarines to Within a Few Feet of Their Actual Location, Etc. The Principle of Triangulation Employed Makes the Invention Extremely Feasible and Precise.

sound waves, i.e., the echo, was based on the phenomenon of sound wave transmission thru the air. Sound travels thru the air at a speed of approximately 1,120 feet per second; it is well to keep in mind also that a sound traveling toward a certain point such as a rock or iceberg and rebounding from the surface of said object by reflection, will cause an echo traveling at the same speed also, or 1,120 feet per second. Hence, when listening for the echo, which you may sometimes do in parks or in mountainous regions where there is a rocky formation which will give a good clear echo at a considerable distance, you may time the distance with an ordinary watch provided with a second-hand, by counting the seconds required to hear the echo. But the time noted should be divided by two, and then multiplied by 1,120 in order to get the distance in feet. Sound wave propagation thru water is very much the same as that thru air, with the difference, however, that sound travels thru water at a much greater velocity than thru air, owing

(*Continued on page* 454)

A Telltale Submarine Net



Submarines Will Have to Become Almost Human to Get Thru the Under-Water Nets and Mines Barrages of To-morrow. Here's a Telltale Net That Entangles the "Sub" and Sends up Rockets Signaling the Fact. Electric Light "Markers" Are Also Brought into Play.

THE vast experience gained by naval designers and inventors during the progress of the great war has taught them many things. The various means of protection against submarines have been quite extensively tried out, and while many theorizers have predicted failure for *anti-submarine nets*, still many hundred miles of nets were constructed and successfully employed during the war. A new form of *telltale submarine barrier* or net was recently invented and patented by one John P. Geraghty, of Jersey City, N. J. His invention covers a system of detecting submarines solely by the use of protective nets, so that anti-submarine operations can be carried out directly, and a few dozen "ash cans" (depth bombs) let go on the spot where the submarine is eventually located by the sub-sea microphones, et cetera, as now used by all of the leading navies.

The outstanding features of Mr. Geraghty's invention are that as soon as a submarine touches the net and tries to cut its way thru, or else bumps the net so hard that it carries it away, telltale signals will instantly be given, and which are effective either by day or by night. At night, rocket signals are shot forth from the anchor buoys of the net as soon as the net has been damaged or carried away by the lurking enemy sub-sea craft engaged on a surreptitious visit to the harbor or bay thus protected.

In this form of anti-submarine protective net, the net, which is of special design, is detachably fastened to sturdy anchoring devices, so that when a submarine strikes the net it can, with ordinary pressure, tear the latter away from the anchorages, which immediately causes signals or telltale means to be operated so that patrol boats, such as submarine chasers and destroyers, can at once give battle to the unseen enemy. The anchoring devices are provided with clever releasing catches, which when a certain amount of pressure is applied to the net, collapse and allow the net to be released from the anchorages. As soon as this happens, however, the collapse of the catches

(*Continued on page* 483)

Electrocuting Huge Leopard

It was a "shocking" affair, but those members of the Los Angeles moving picture colony who are in the habit of working with animals are breathing sighs of relief, for David, the big leopard of the "movie" jungle is no more. Sentenced to death by a jury of his peers, the big cat paid the extreme penalty by being electrocuted. According to Mr. Edwards, manager of the film company who owned the beast, most of the animals used in film work are very tame, but David had been acting treacherously for several months, and rather than risk the injury of anyone who might be acting with him it was decided to end his career. At first shooting with a high-powered rifle was considered, but fearing that this would disfigure the beautiful pelt which the company wished to preserve, the engineer of a large electric power station nearby was consulted and electrocution was decided upon. A large steel plate was placed on the floor of the cage and connected to a 6,000-volt power line at the power house. David was then placed on the plate, and another wire fastened to his leg, the juice turned on, and David was no more.

The execution of animals has received considerable investigation, especialy in the city of Boston, Mass., where there is located a specially equipt institution for electrocuting horses, cats, dogs, etc. The apparatus and special provisions arranged to carry out this work were described some time ago in the ELECTRICAL EXPERIMENTER. The method is not only advantageous in many different ways, such as the ease and certainty which which the animal may be killed, but also has received the highest commendation from humane investigators and scientists. The theory of electrocution tends to show that the high velocity of the current travels faster than the nerve wave itself, and therefore the animal is dead before any shock can be felt.

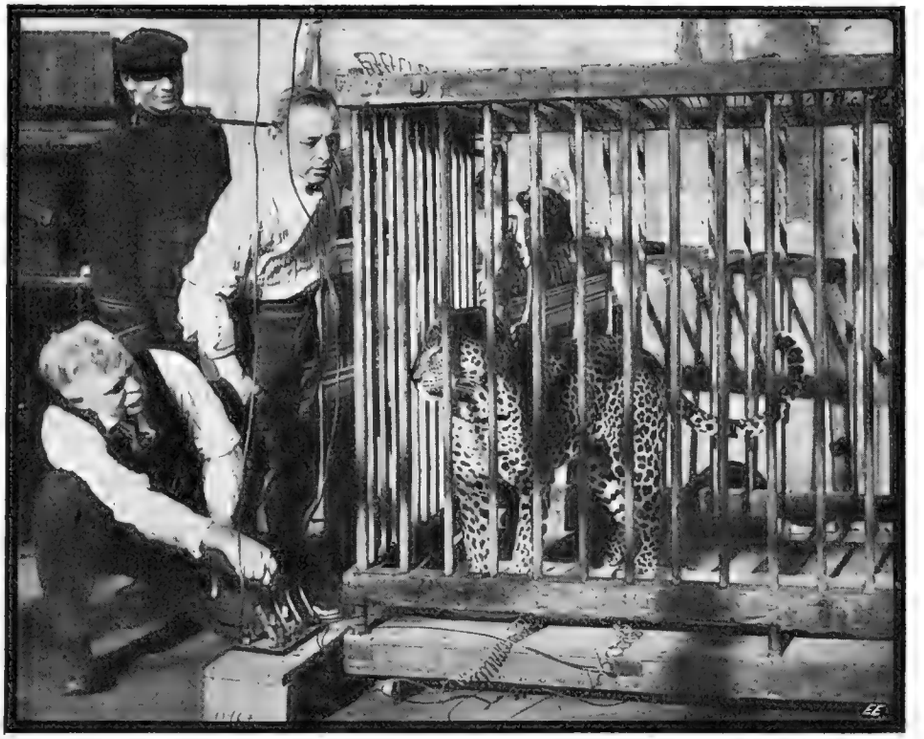


Photo by Keystone

"David"—the Big Leopard of the "Movie" Jungle—About to Breathe His Last. One Throw of the Switch and He Paid the Final Penalty for His Treachery, Which Had Endangered the Actors' Lives.

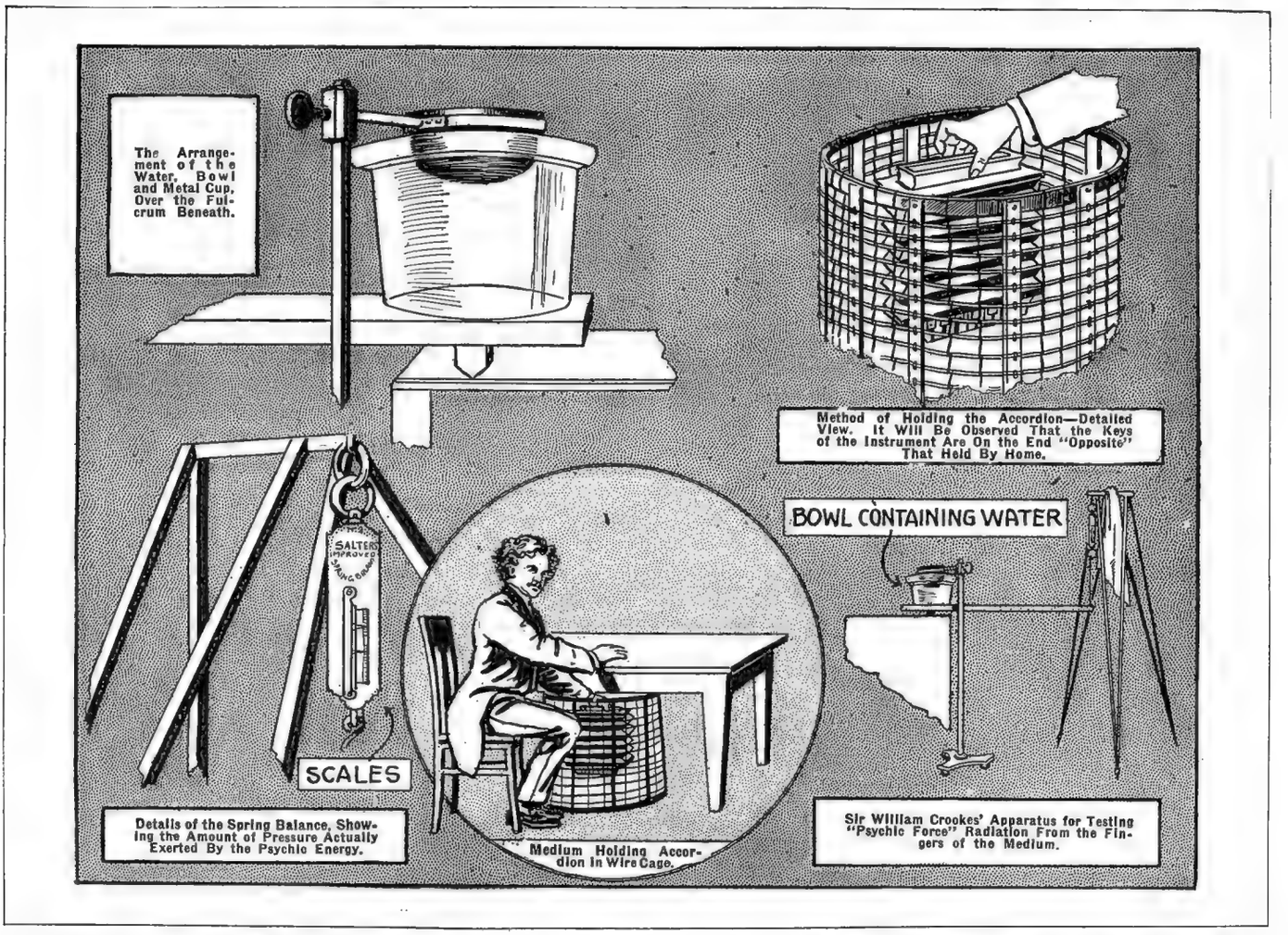
Sir William Crookes' Psychical Researches

By HEREWARD CARRINGTON, Ph. D.

THE late Sir William Crookes, O.M., F.R.S., will always be regarded as one of the greatest scientists—as he was one of the greatest "psychical" students—of all time. His achievements in the fields of chemistry and physics alone insure the perpetuation of his name in scientific circles. He was the discoverer of the element thallium; he it was who first investigated many of the phenomena of radiation, which led to the ultimate discovery of the "Crookes tubes"—named after him—and which in turn have led to many important discoveries in the realms of chemistry, physics and medicine (the X-rays, etc.). He made many valuable contributions to the study of radium; he invented the "radiometer," which we now see in nearly every oculist's shop; he wrote many standard works upon chemical analysis, sugar manufacture, dyeing, printing, metallurgy, sewage, diamonds, and many other topics—thereby establishing his name as one of the finest, most ingenious and most practical scientific minds in the world, and leaving to posterity a veritable monument, in the shape of lasting and valuable achievement, of great practical benefit and value to mankind.

Sir William Crookes, however, was known not only for his interest in the problems of physics and chemistry, but also by reason of his interest in "psychic" phenomena, and his book "Researches in Spiritualism" is a classical manual on the subject, oft quoted, and a model of clarity and impartiality. Curiously enough, his researches into the phenomena of spiritualism were being undertaken during the very years (1870-74) when, in the opinion of many physicists, Sir William was doing his best work in chemistry, so that the charge cannot be brought against him that "he only became interested when in his dotage"; on the contrary, he was then in his prime—about forty years of age. It is true that Crookes maintained his interest to the day of his death, but he *wrote* very little upon the subject, contenting himself with patient research and investigation, which tended but to confirm his earlier researches. A brief summary of these cannot fail to be of interest.

Scientific Proof of Psychic Force or Spiritualism

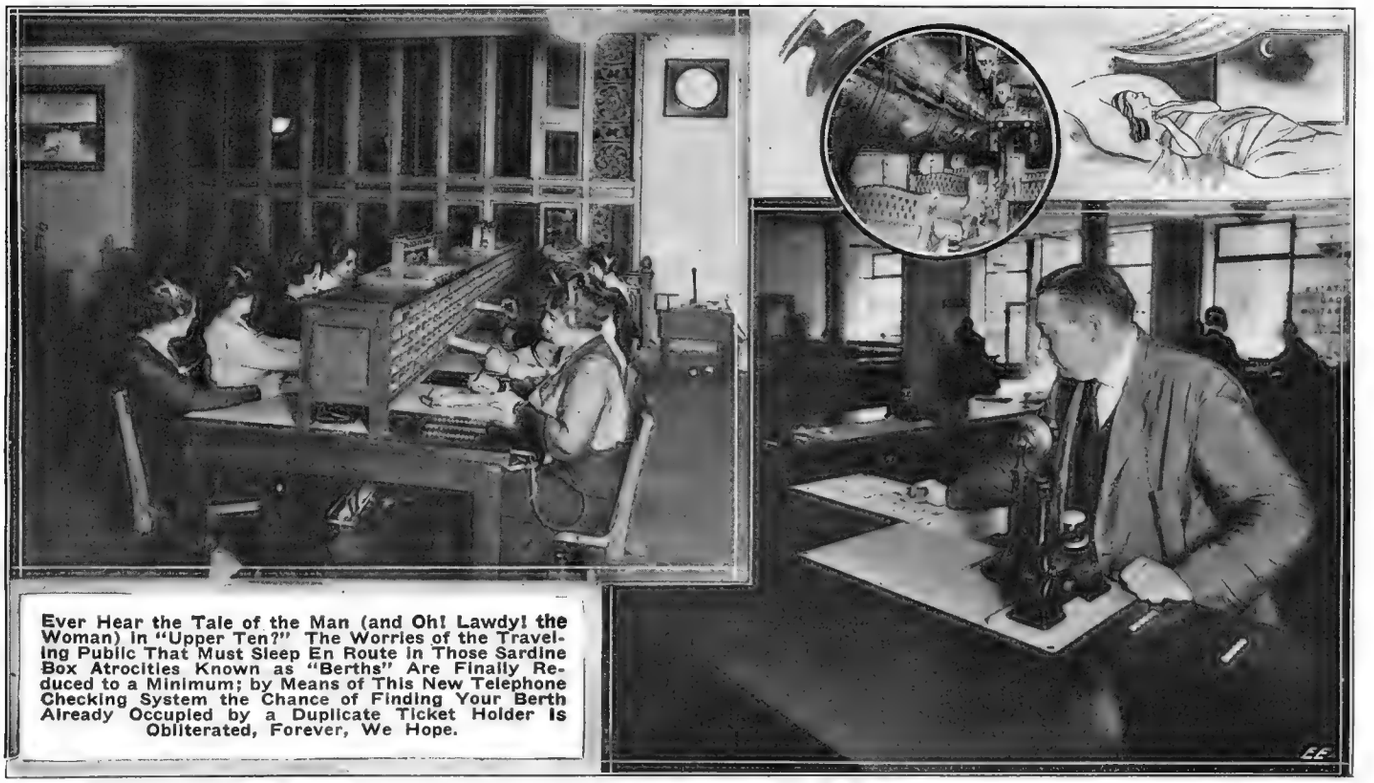

The Arrangement of the Water, Bowl and Metal Cup, Over the Fulcrum Beneath.
Method of Holding the Accordion—Detailed View. It Will Be Observed That the Keys of the Instrument Are On the End "Opposite" That Held By Home.
BOWL CONTAINING WATER
SALTER IMPROVED SPRING BALANCE
SCALES
Details of the Spring Balance, Showing the Amount of Pressure Actually Exerted By the Psychic Energy.
Medium Holding Accordion in Wire Cage.
Sir William Crookes' Apparatus for Testing "Psychic Force" Radiation From the Fingers of the Medium.

IN publishing this article, we are aware that it is a very unusual subject to appear in a scientific magazine. We however, have approached the matter with an open mind, neither condemning nor upholding it. The reader must be the judge. We do not publish it with the mental reservation that "there might be something in it, after all," but we do believe that anything at all in science over which there has been a great controversy should be discussed as intelligently as it is possible. The author of the present article, Dr. Hereward Carrington, is a member of the Society of Psychical Research, and he is also the author of several interesting books, among others "Death: Its Causes and Phenomena;" "The Problems of Psychical Research;" "The Coming Science;" 'Psychical Phenomena and the War."

Sir William Crookes, one of the greatest scientists that ever lived, became converted to spiritualism after long and exhaustive experimental evidence which today seems irrefutable. Dr. Hereward Carrington clearly describes some of Sir William's experiences in this article, which should prove of unusual interest to our readers, whether it will convince them or not.

The majority of these experiments—which were chiefly conducted in Sir William's own home or laboratory—were made with the medium Mr. D. D. Home—a medium who produced extraordinary "physical" manifestations, and who was never detected in fraud in all his long career (Home was an intelligent man, who wrote several excellent books upon the subject himself). One of the earliest experiments was that with an accordion, held lightly between the thumb and fingers of Home's hand by the end *opposite* the keys. His other hand was visible and rested on the table. The accordion, thus held, was placed within a circular wire cage, which could be charged

(*Continued on page* 440)



Ever Hear the Tale of the Man (and Oh! Lawdy! the Woman) in "Upper Ten?" The Worries of the Traveling Public That Must Sleep En Route in Those Sardine Box Atrocities Known as "Berths" Are Finally Reduced to a Minimum; by Means of This New Telephone Checking System the Chance of Finding Your Berth Already Occupied by a Duplicate Ticket Holder Is Obliterated, Forever, We Hope.

Telephone Solves "Lower Berth" Squabble

THOSE of you who have tried in vain to obtain a *lower berth* on a railroad train, only to find out that a friend of yours purchased one from a different window *after* you applied for yours, will doubtless be interested in the new method of booking applications which is in use at the present time at one of the large railroad terminals in New York City.

According to the old method, diagrams of each pullman car, with blank spaces for each berth, were distributed among the various stations and ticket offices. When you purchased your ticket, the number of your train ticket was entered in the space representing your berth. In this way the ticket agent knew just what berths were occupied and which were not. Yes, he did!

When the train left the station these cards were handed to the pullman conductor, who settled disputes as to the occupancy of the berths, according to the ticket number entered on his card. If two people claimed the same berth, the one whose ticket number appeared on the card was the fortunate individual.

(*Continued on page* 481)

New Continuous Panorama Advertising Display

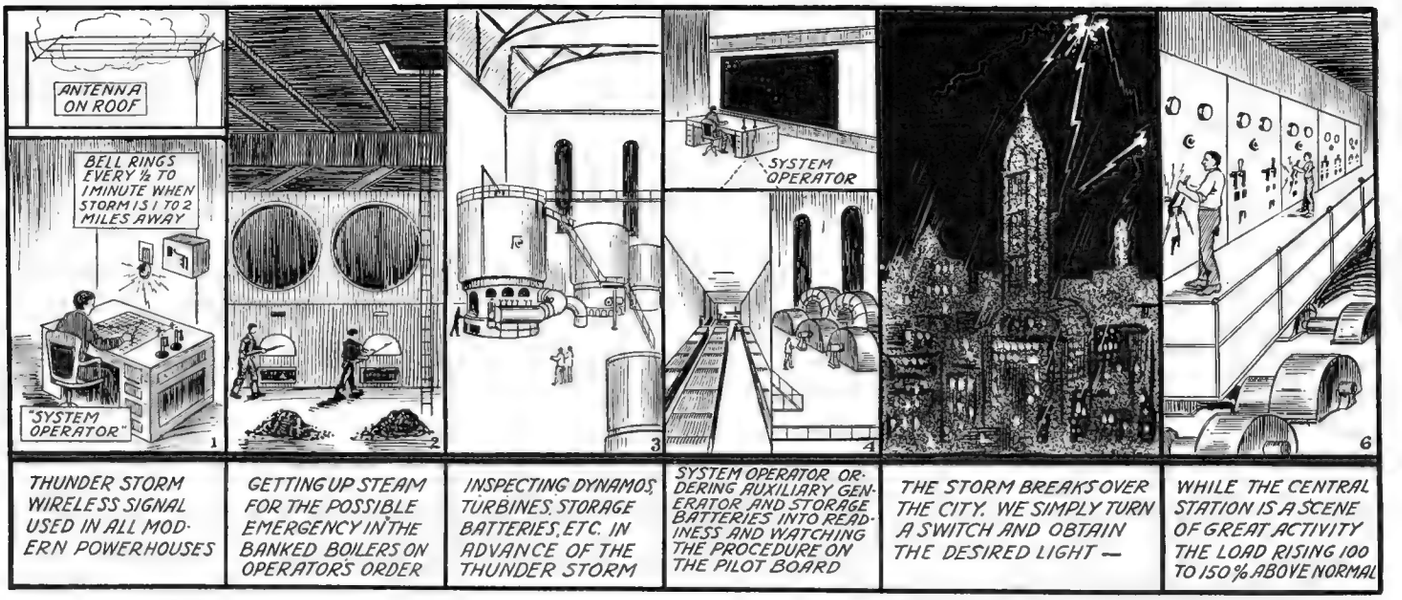
It is undoubtedly a fact that the long suffering public has been wont to see many advertising devices both good and bad exhibited in store windows, etc., designed with the intention (?) of securing their attention. Of these some have been rather unique and served their purpose admirably, but there have been many that have fallen by the wayside.

With these few words of introduction to our plot we come up against the difficult task of describing this new advertising device that to all intents and purposes eclipses them all. The main difficulty is to find a way that will make the explanation reasonably clear. It is

A Mystifying Show Window Attraction—the Scene on the Revolving Disc Constantly Changes.

called the "Endless" display machine, and as an advertising specialty it seemingly surpasses anything heretofore shown, in that it presents to a manufacturer, dealer or storekeeper a very neat and attractive way of telling the history of the manufacture of the goods he may be selling, with a wonderful grouping of photos much the same as a moving picture or panorama. It is only by some such means that customers are usually interested, as the eye readily transmits a picture to the mind that is bound to stick. In addition to the continuous moving picture there are a number of shelves provided at the base for the display of small wares.

The circle covered by the moving disc is thirty inches in diameter, and is capable of showing three separate pictures on each sheet. It is adapted to display any advertising matter which is now used or has been used in posters, car cards, phrases, and in fact all written, printed or photographic matter. Each machine can hold 20 or more sheets each thirty inches in diameter; they are notched around the edge with a tough linen border which precludes their becoming torn or mutilated while passing thru the machine. The discs are slit and joined end to end in a flat pile inside the machine with the two free ends joined in a sort of twist, thereby enabling the action to be continuous both back and front. They are held in place both by a pivot in the center and also by the driving motor, which is of 1/40 horse-power and so geared that two friction pulleys bear on each side of the machine. Between these pulleys are set the edges of two discs and by a simple gearing process, each set of friction pulleys works in the opposite direction, thus making possible the continuously moving panorama.

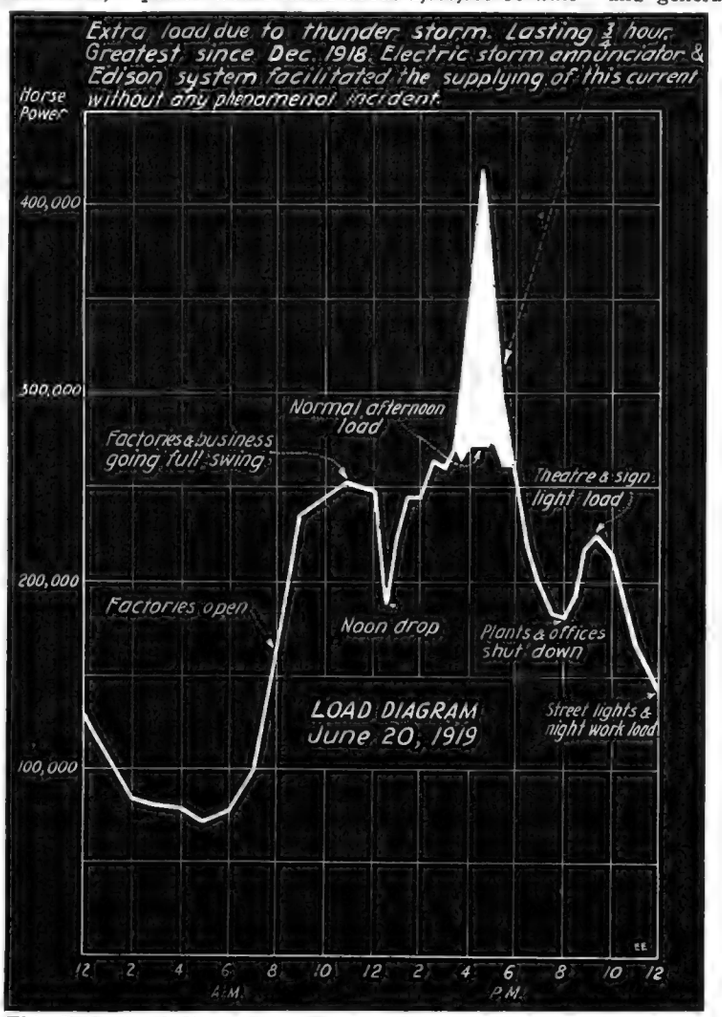

ANTENNA ON ROOF
BELL RINGS EVERY ½ TO 1 MINUTE WHEN STORM IS 1 TO 2 MILES AWAY
"SYSTEM OPERATOR"
1
2
3
SYSTEM OPERATOR
4
6
THUNDER STORM WIRELESS SIGNAL USED IN ALL MODERN POWERHOUSES
GETTING UP STEAM FOR THE POSSIBLE EMERGENCY IN THE BANKED BOILERS ON OPERATORS ORDER
INSPECTING DYNAMOS, TURBINES, STORAGE BATTERIES, ETC. IN ADVANCE OF THE THUNDER STORM
SYSTEM OPERATOR ORDERING AUXILIARY GENERATOR AND STORAGE BATTERIES INTO READINESS AND WATCHING THE PROCEDURE ON THE PILOT BOARD
THE STORM BREAKS OVER THE CITY. WE SIMPLY TURN A SWITCH AND OBTAIN THE DESIRED LIGHT —
WHILE THE CENTRAL STATION IS A SCENE OF GREAT ACTIVITY THE LOAD RISING 100 TO 150% ABOVE NORMAL

200,000 Horse-power in One Hour

ON Friday, June 20th, 1919, the electric light and power service of the New York Edison Company was put to the severest test which the Waterside Station had ever experienced since December, 1918. This was a day on which a summer thunder-storm, coming up in midafternoon enveloped the city in darkness equal to that of 10 o'clock at night, the consequence being that about 2,000,000 electric lights were turned on almost instantaneously and the Edison Company had to meet this demand for more "juice." It occurred when factories and offices were going at full swing, hundreds of which suddenly switched on all the lights when the storm broke. Several factors enabled the company to supply the enormous demand for current. One of these we have described in a previous issue of the ELECTRICAL EXPERIMENTER—the "wireless storm announcer," which again stood in good stead.

This consists of a slightly modified form of an early model wireless receiving station, using a *coherer* and a bell as a decoherer, together with the necessary relays. In addition in the aërial circuit, are two spherical balls resembling a spark gap. These are placed 1-64th inch apart, and are used to prevent the causing of a false alarm by the surges emanating from nearby wireless telegraph sending stations. A condenser is placed in the ground circuit to prevent stray currents and a short-circuiting switch is used to silence the bell and protect the apparatus from heavy surges due to electrical storms, which may harm the apparatus and materially impair its usefulness.

The demands of this generating station were raised by this increase in the use of current from approximately 250,000 horsepower, which is the normal daily business load, to nearly 425,000 horsepower, and due to the fact that all offices and factories were "carrying on" at the time; this load would naturally be almost exclusively of a lighting nature. From these figures an increase of 175,000 horsepower would mean about 2,000,000 50-watt lamps being turned on suddenly. Naturally enough, something had to be done in order to meet this demand, and inasmuch as the change from normal to the *peak* load came within less than an hour, it involved a close race against time to get the boilers and generators into operation in time to meet the approaching darkness that the coming storm would bring.


Extra load due to thunder storm. Lasting ¾ hour. Greatest since Dec. 1918. Electric storm annunciator & Edison system facilitated the supplying of this current without any phenomenal incident.
Horse Power
400,000
300,000
200,000
100,000
Normal afternoon load
Factories & business going full swing
Theatre & sign light load
Factories open
Noon drop
Plants & offices shut down
LOAD DIAGRAM June 20, 1919
Street lights & night work load
12 2 4 6 8 10 12 2 4 6 8 10 12
A.M.
P.M.

This Daily Load Chart Shows How the New York Edison Company's Output Increased Nearly 100% During a Recent Thunder-Storm.

At a large generating station such as at Waterside, there is generally one man and his assistants, who are able to conduct the affairs of the station with remarkable skill and precision—the "system operator," as he is called at Waterside. The system operator invariably keeps posted on the demands that are or may be made on the station for power and light, so as to direct the disposal of all generating machinery. Thus the station will afford the highest quality of service and will operate with maximum efficiency, i.e., he ascertains how many boilers should be maintained under load, and how many should be "banked," which machines shall carry the load and which shall remain idle. He also directs the switchboard operators as to which feeders shall be used to dispose of the output. As this routine is an everyday affair, it is conducted quite automatically, but the life of the system operator also has some of its thrills, especially when a storm approaches the city at a rate of about 45 miles an hour. The little thunder-storm detector, a view of which is reproduced here, does its share of the work. When a storm is approaching, and about one to two hours away, the gong on this storm announcer will strike about every fifteen or twenty minutes. This is only a "warning," and not much attention is paid to it, as it is very probable that the storm

(*Continued on page* 450)

Possibilities of High Frequency Currents

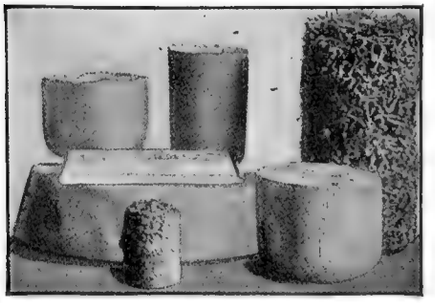
By JOHN E. PRITCHARD

IN all branches of human endeavor there has been that characteristic trait to attain perfection. This condition has never been reached and never will; but like a variable approaching a limit, the difference between perfection and non-perfection can be made very small.

In the early development of electrical application, it was generally conceded that direct current transmission was a marvelous advance toward the ideal method of power delivery. Its flexibility over all others was evident, at that time. This advancement opened a new field of industrial engineering. Investigators were spurred on by successes, so naturally the field became extensive. Then the *disadvantages* of direct current became prominent. Economy demanded that power units be centralized. It was found that to transmit large currents long distances at low voltage, required very *large conductors* to reduce the heat losses, which are equal to the current squared, multiplied by the resistance. This draw-back was partially surmounted by the high voltage direct current generator; but due to the mechanical as well as current transformation difficulties, it has not been widely adopted.

LOW FREQUENCY ALTERNATING CURRENTS

Low frequency 60 cycle A. C. machinery, thru persistent research, has to-day reached



Melts From the High Frequency Furnace, Some of Which Resist Fusion Up to Temperatures as High as 1700° Centigrade. Such Include Tin, Lead, Zinc, Aluminum, Brass, Copper, Iron Cast and Electrolytic (Which Was Melted In Vacuum Without the Presence of Carbon, Even In Traces), Nickel, and High Silica Glass. As an Interesting Indication of the Unique Character of the Induction Possible, a Mass of Small Iron Nails Is Shown at the Extreme Right, Which were Cintered Together by the Action of Powerful "Eddy Currents." While This Action Is Proceeding, During the Early Stages of the Melting, Small Arcs and Sparks Tend to Weld the Many Particles Together. This Effect Is Obtained Only In a Crucible That Is Electrically Non-conducting.

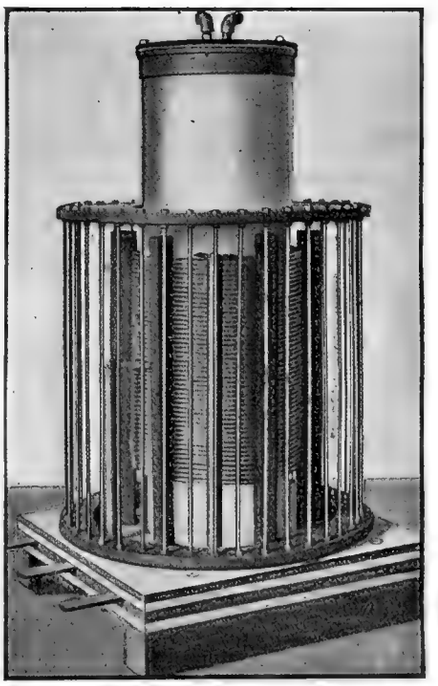
a high degree of perfection. But even with our great power houses and their long transmission lines lighting great cities, propelling ponderous electric trains over high mountains and furnishing energy for every conceivable form of prime-mover in the industries, there exist many factors detrimental to perfection.

The reason for the great use of alternating currents is the ease with which they can be *transformed from one voltage to another.* They can be generated at a comparatively low voltage and stept up to a higher voltage. In the transmission of great power at *high voltage* there is required but a *small current,* and this, in turn, requires only *conductors of small cross-section.*

RESONANCE IN A. C. CIRCUIT.

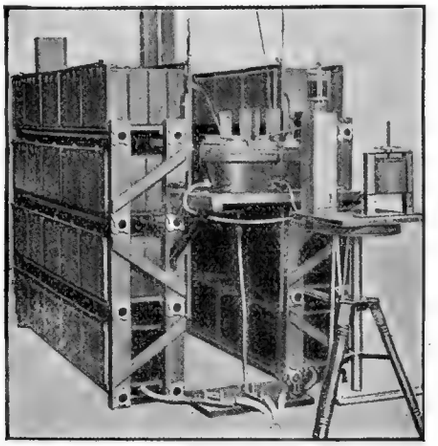
Transformation is accompanied with

The High Frequency Furnace and Electric Power Transmission



Typical Vacuum-Type Inductor Unit of New High Frequency Furnace Developed by Prof. Dr. E. F. Northrup, Princeton University, Marking a New Era in the Electrical Refinement of Metals.

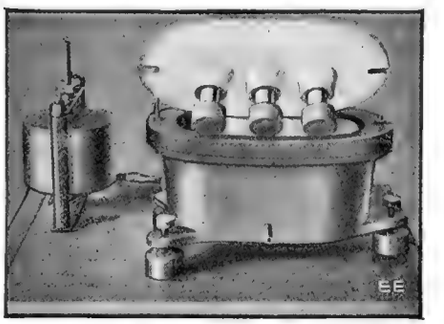
heat, magnetic leakage, hysteresis and eddy current losses. First class design has reduced these to a minimum. Also, there are *disadvantages* caused by inductance and capacity in every circuit. This lowers the *power factor.* The lower this is, the more current is required to produce power at a given voltage. This gives rise to excessive heat losses. The power factor may be made unity or nearly so, by *balancing* the reactive effects of inductance and capacity. When this condition exists, resonance is said to take place in the circuit and then



High Frequency Electric Furnace Condensers and Spark Gap. These Furnace Outfits Have Been Built In Sizes Up to 50 Kilowatts.

Ohm's law holds true, C=E/R. It is very desirous not to have this in practise, due to the great strain placed on the circuit. The voltage, as well as the current, may reach abnormal values under such conditions. In fact, the potential on a long transmission line may be 10 per cent higher at the distant end than at the generator end, due to these resonance conditions. In one case a 10,000-volt A. C. transmission line showed 11,000 volts at the distant or load end of the circuit.

This phenomenon may be illustrated by the mechanical analogy of a pendulum six feet long, on the foot of which is hung a weight of one hundred pounds. Strike the weight with a force of ten pounds. Call this the *positive* impulse. When it has traveled the full length of its arc, give it another ten pound blow. This is the *negative* impulse. Now the pendulum will oscillate freely. The time for a single vibration will always be equal, regardless of the length of its arc; therefore the impulses will occur at equal intervals of time and will be analogous to an alternating current delivered to a resonant circuit. The amplitude of the swing will get greater and greater until finally the energy represented in the moving weight is *many times larger than the individual impulses.* These are called *free vibrations.* But if the forces are not applied at the instant of the weight's



Interior View of Discharge Gap. The Discharge Gap Shown Is Adapted for Either Single or Two-Phase Operation. It has No Moving Parts and Is Substantially Noiseless. The Gap Is Very Effective In Producing Strong Oscillations and May Be Employed for the Conversion of Large Amounts of Power Into Oscillatory Currents.

return to center, part of the energy will be lost in heat. These are *forced vibrations.*

Alternating currents, in present day practise, applied to induction motors and transformers, are impeded by resistance, inductance, and capacity; giving rise to these forced vibrations. This condition causes voltage drop, low power factor, hysteresis or iron losses, and eddy current losses. A *synchronous motor* on the line with an over-excited field, furnishes an equivalent of capacity and tends to neutralize inductance and thereby makes the vibrations free. A condenser would do the same, but it would be too large to be practical.

HIGH FREQUENCY ALTERNATING CURRENTS.

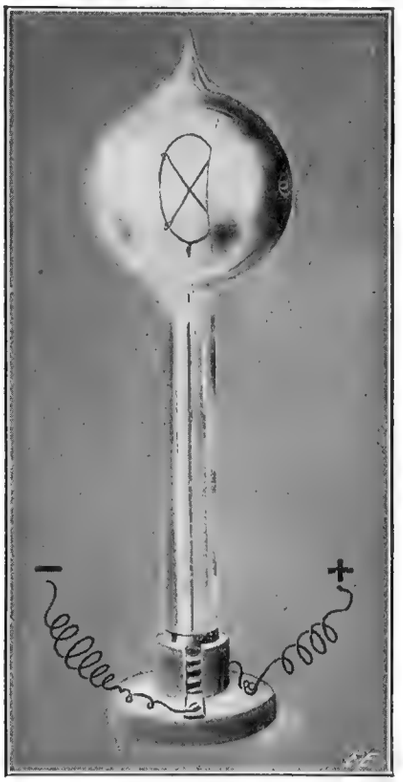
High frequency alternating currents and machinery for producing them are comparatively new. This field of application is not extensive. There has been considerable development on the large scale in wireless telegraphy and telephony. But here the power has not, up to the present time, exceeded a few hundred kilowatts, and it

(*Continued on page* 474)

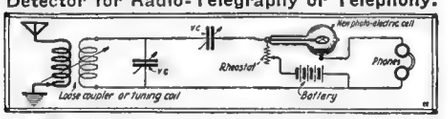
NEWEST ELECTRICAL DEVICES

PHOTO-ELECTRIC CELL SUPPLANTS SELENIUM.

Experimenters in many fields of science, including those interested in astronomy and certain branches of the electrical and radio arts, have very often faced the problem where to obtain a good selenium cell—



New Light-Sensitive Photo-Electric Cell and Below—a Diagram for Using the Cell as a Detector for Radio-Telegraphy or Telephony.



the well-known instrument which, when exposed to light, lowers its electrical resistance, thereby causing a relay connected with it to operate one or more local circuits. Not only was the question of where to obtain the cell often unanswerable, but the best selenium cells which have been available now and then on the American market have left much to be desired. This is so for several reasons. First, the element *selenium*—even tho it possesses a most wonderful natural quality of changing its electrical resistance in proportion to the amount of light thrown on it, and raising its resistance as the degree of darkness is increased—does not do this instantaneously, nor anything like it.

The newest advance in science is the *photo-electric cell.* This device, which has only recently been perfected so as to be available on the commercial market, is shown in the accompanying illustration and diagram. Not only is it useful where *light-operated* circuits are necessary and desirable, but it can moreover be used for receiving radio signals, as its designers have pointed out. Its arrangement in the radio receiving circuit is shown in the accompanying diagram.

The photo-electric cell apparatus is somewhat similar in principle to the selenium cell, in that it changes its inherent electrical resistance in proportion to the amount of light falling upon it. As its designers and builders state, the cell is not liable to lag as in the case of selenium, and there is no dark current whatsoever. It is said to be very constant and reliable in its action, and can be used to great advantage in stellar photometry. The applied potential for this cell is 220 volts. A cell of this type has a wider field of usefulness in many respects than a selenium cell, and it will carry a considerably larger current.

This photo-electric cell is very cleverly made up with a screw base fitting a candelabra socket. The rubidium screen inside the bulb connects to one terminal of the screw base, while a wire leads down from the silvered glass electrode facing the screen to the second contact member of the screw base. All that is necessary in connecting up the cell is to attach the two circuit wires to each of the two terminal screws on the base.

MAKING YOUR OWN FLASHLIGHT BATTERIES.

One of the latest advances in the flashlight art is the home-made battery outfit illustrated in the accompanying photograph. These outfits are priced so as to give about 25 per cent reduction in the cost of the batteries if purchased in the regular way, and each outfit will make three *two-cell batteries* or two *three-cell batteries,* there being suitable materials included to make up six flashlight battery cells. The outfit is supplied in two styles—one battery outfit includes a tubular flashlight, while the second outfit has a renewal equipment only, comprising the necessary parts, chemicals, etc., to make the six single cells as aforementioned.

As the makers point out in their instruction brochure accompanying the battery outfit, one of the principal advantages of this set is that the cells do not deteriorate in the least while they are standing, and so the person using these flashlight batteries has the satisfaction of knowing he is adding from 50 to 100 per cent to the life of his flashlight battery, which ordinarily is wasted, so far as the life of the battery is concerned, by standing on dealers' shelves, and in transit between the factories and dealers.

The liquid solution used in mixing the paste for the cells is placed in a graduated bottle. The proper quantity for each cell is marked off on a graduated label, which shows just what quantity to pour into each cell. Next, a chemical powder is placed in the solution and stirred well with a mixing stick accompanying the set. The carbon element, after being immersed in water for a few moments, is placed down

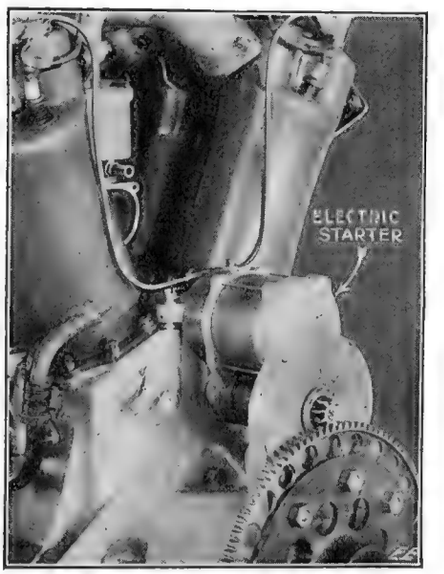
The Latest in Flashlights! Make Your Own Batteries.

into the zinc cylinder containing the solution, which has been thoroly stirred, and by pressing the cork supporting the carbon element down flush with the zinc cup, it is held firmly in place by bending over three zinc prongs. A cardboard cylinder suitable for holding three cells accompanies the outfit.

NC PLANES HAD ELECTRIC SELF-STARTERS.

It is not generally known that the NC flying boats which accomplisht the successful trans-Atlantic flight were the first heavier-than-air machines in this country to be equipt with electric self-starters for each of their big Liberty engine motors.

The result of the Navy Department's decision to so equip its seaplanes undoubtedly aided the success of the enterprise, for the NC-3, lost in the sea and fog near the



The Famous "NC" Planes Had Their Liberty Motors Fitted with Electric Self-Starters, as Shown in the Photo Herewith.

Azores, all her engines stalled, wet and cold, would never have been able to taxi into Ponta Delgada under her own power without the assistance of mechanical means for starting her propellers.

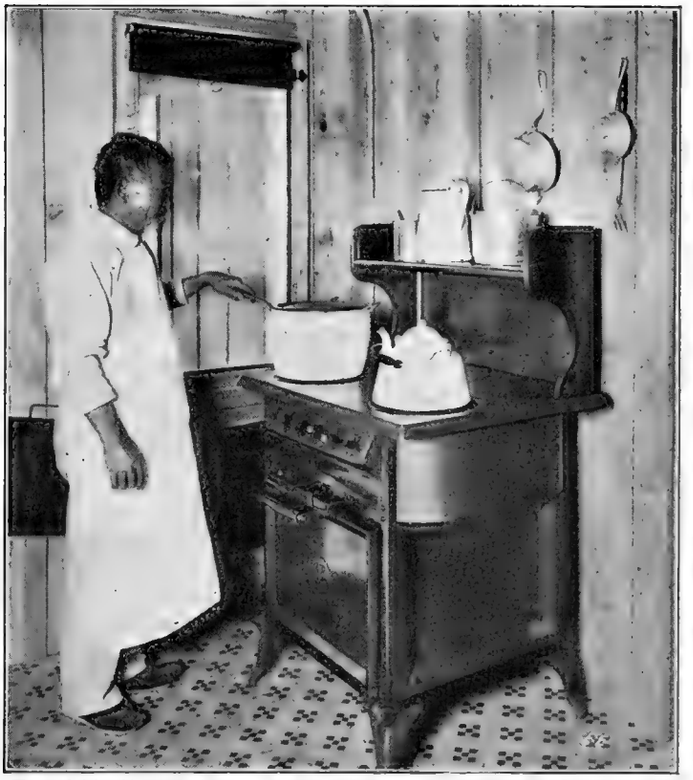
The picture shows this little starter attached to the propeller shaft of one of the big Liberty motors which drove our seaplanes thru the air.

This little device consists of a small 12-volt electric motor operated by a storage battery, connected thru a geared reduction to an automatic screw drive. On the end of the screw shaft is cut an 8-tooth pinion which meshes with a larger gear mounted on the propeller shaft. The starter will turn over the engine at 40 to 50 R.P.M. with a consumption of 100 to 110 amperes and a maximum of 1,300 foot-pounds is available on the engine crank shaft, for breaking loose a cold engine. When the engine begins firing the screw drive automatically demeshes from the crank shaft gearing. The storage battery weighs 26 lbs., and has a rating of 24 ampere-hours—or sufficient to supply enough current to make 150 starts on one charging.

An interesting incident of the American trans-Atlantic flight was that all three planes carried extra propellers, intending if one should break to descend to the water, change propellers, and start off again. They depended on the starter to make this possible.

It is also said that the C-5 (Blimp) met such strong headwinds on her trip from Montauk Point, Long Island, to Newfoundland, that the force of the wind stopt her propellers, and it was necessary to ascend to a higher level to avoid them, the starter with which she was equipt starting the engines while in mid-air.

Photo courtesy Westinghouse Electric and Manufacturing Company.



Even This Chinese Chef Likes to Cook on the Modern Electric Range. Meals Are Prepared on This Range for Workers on a California Ranch.

How Cool and Orderly the Electric Range Kitchen Looks. No Heat Wasted Here in Warming Up the Kitchen and No Smoke, Gas or Smell.

Electric Cookery—A Snap!

By GRACE T. HADLEY

Society for Electrical Development

THE history of human culture might be said to be largely the science of food preparation. Thru the ages the arts of fire were slowly developed. Wood, coal, oil and gas have been successively used in the production of artificial heat for the purpose of cookery. Until the last century fire was the most useful thing in the service of man.

To-day electricity is doing all that fire ever did, and is doing it better. Electric cookery is as superior to fire cookery as the electric light is to the tallow dip. Electricity is performing tasks beyond the limits of flame. Fire to-day yields motive power with many times the economy it did one hundred years ago. This motive power is the source of modern electric currents. This power as electric current enters silently and swiftly into the modern home and is the source of electric heat in the modern cook stove.

As refinement of living increases, electric cookery solves the problem of easy control, of elimination of waste, the uncertainties of temperature. The heat can be regulated with almost mathematical precision. When it is no longer needed the current can be turned off and no waste occurs. The time is close at hand when cookery will cease to be carried on by "guess-work." Many women already realize that it pays to put this work on a more scientific basis.

The temperature factor in cookery is one that ought to be thoroly standardized. In the art of baking a loaf of bread, for instance, there are many factors that must be precise, in order to insure best results. There is no reason, if conditions are exactly the same, especially temperature conditions, why the cook should not be successful with her baking, regardless of "wind in wrong direction."

The objects of cookery are to render food more digestible, to make the food more appetizing and to improve its appearance. In the cooking of animal food, the improvement of appearance and flavor is most important. Cooking foods rich in protein may decrease digestibility to some extent, but the increased attractiveness of well-cooked meat may render it more digestible by causing greater flow of digestive juices.

ROASTING.

Roast Beef.—Remove the baffle plate. Turn both oven switches to *High* and let oven heat twenty minutes. Place the roast on the rack in the dripping pan, rub with salt and dredge the meat and pan with flour. Put in the roast to sear for about four minutes to each side. Then put in the baffle plate and turn *lower* oven switch to *Medium*. After twelve or fifteen minutes turn the *upper* oven switch to *Medium*. The total time of roasting should be fifteen minutes to the pound. If the meat is lean, put drippings or hot water in pan for basting.

There is said to be a saving of about 15 per cent in roasting meat electrically. Considering the price of meat to-day, this is quite an item. The following actual test of a 4 pound roast is interesting, illustrating the exact steps in the process of roasting the meat and the actual loss of weight by shrinkage:

Weight of roast, 4 pounds.

Preheat oven to "4," requiring twelve minutes at 110 volts.

Prepare roast; turn upper unit off.

Roast on "Full" five minutes per pound (lower unit).

Roast on "Medium" five minutes per pound (lower unit).

Roast on retained heat one hour.

Weight after roasting process, 3 pounds, 7 ounces.

Time of roasting, 1 hour 40 minutes.

Watts, 990.

Roast Chicken.—Turn the oven switches on *High* for twenty minutes in advance. Run the chicken over with soft butter and salt, dredge chicken and pan with flour. When the flour is well browned reduce the oven heat to *Medium;* baste well. When the breast meat is tender the chicken is sufficiently cooked. A chicken requires about one and a half hours, or about twenty-three minutes to the pound.

BAKING.

Biscuits.—The best results are obtained by having a hot oven to start with, so turn oven switches on *High* for thirty minutes in advance. If pans are placed on middle grate the biscuits will bake an even brown on top and bottom in ten minutes. If placed on the top grate the pans will need changing to the bottom grate as soon as the biscuits are well browned on top. Leave the oven switches on *High* during entire baking.

Bread.—Turn oven switches on *High* for thirty minutes in advance. The loaves should begin to brown in the first fifteen minutes of baking, after which the heat should be reduced to *Medium* for thirty minutes.

Muffins.—Turn over switches on *High* for twenty minutes. Bake twelve to fifteen minutes on *Medium* heat.

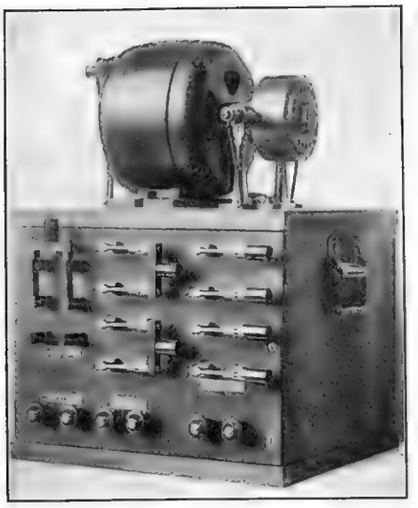
Sponge Cake.—Place the cake in a cool oven. Turn the oven switches on *High* for ten minutes, then to *Medium,* and bake from thirty to forty minutes longer. The cake is done when it falls back to a level and springs to the touch.

Cup Cakes and Pastry Shells.—Turn the

(*Continued on page* 451)

New Things Electrical

A NOVEL ELECTRIC FAULT LOCATER.



A Novel and Efficient Fault Locater for Electrical Testing of Cable and Transmission Circuits. It Detects and Locates Faults On Cables Carrying As High As 15,000 Volts.

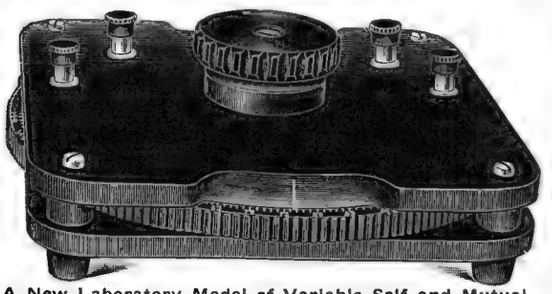
The new electric *fault locater* is a device designed for the purpose of locating all kind of faults that are inherent on overhead electric lighting and power lines carried on poles, and also on lead covered cables insulated with paper, rubber or cambric, which may be drawn into underground conduit systems.

The device is claimed to be capable of detecting and locating the faults upon cables carrying a working pressure up to 15,000 volts, alternating current, 60 cycles frequency. This apparatus is fitted with a special analyzer and interrupter.

Another valuable feature of this apparatus is that it readily locates grounds and short-circuits on steel taped armored cable, two or three conductor, laid directly in the earth.

A VARIABLE SELF AND MUTUAL INDUCTOMETER.

The inductometer illustrated herewith consists of two pairs of stationary coils and one movable coil, the latter being mounted on a disk placed between two outer plates holding the stationary coils. The disk may be rotated and has two scales, one calibrated in millihenries reading self-inductance and the second in degrees. The instrument is ordinarily provided with a maximum inductance of 50 millihenries, but instruments with higher maximum values or lower values can be obtained.



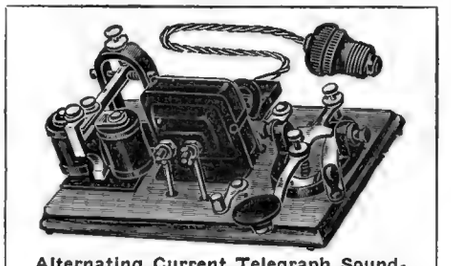
A New Laboratory Model of Variable Self and Mutual Inductance, Having a Maximum Inductance Value of 50 Millihenries. Larger Sizes of the Inductometer Are Available.

The inductometer has six link-shaped coils. The four fixt coils are mounted in pairs in the two outer fixt plates, which are held together by four screws and separating pieces to form the body of the instrument. The two movable coils are mounted on the inner disk and are placed with their long axes at right angles to a diameter. The outer plates and the disk are made of molded bakelite. To use the instrument as a variable mutual inductometer the fixt and movable coils are used as primary and secondary respectively and no connection is made between them. The mutual inductance is found by subtracting a constant from the scale reading and dividing the remainder by two. This constant is given with each instrument, altho it may be readily determined by the user at any time. It is claimed that errors due to stray field effects are eliminated and that the meter has a desirable ratio of maximum inductance to minimum inductance.

ALTERNATING CURRENT TELEGRAPH INSTRUMENT.

This A. C. telegraph instrument consists of A. C. sounder, steel lever key, and step-down transformer, mounted on base, as shown in illustration, with cord and attachment plug. No battery is used with it. It can be used on the 110 volt, 60 cycle alternating current lighting circuit by screwing the attachment plug into lamp socket.

Two or more instruments may be connected in series, just the same as instruments with batteries, by attaching the primaries of the transformers in multiple to the 110 volt 60 cycle lighting circuit with the secondaries and the sounders all in series, which is done by simply screwing the attachment plugs into lamp sockets and connecting the instruments in the usual way, thru their binding screws or terminals. Two terminals or binding posts and a single point switch are mounted on the base of each instrument.



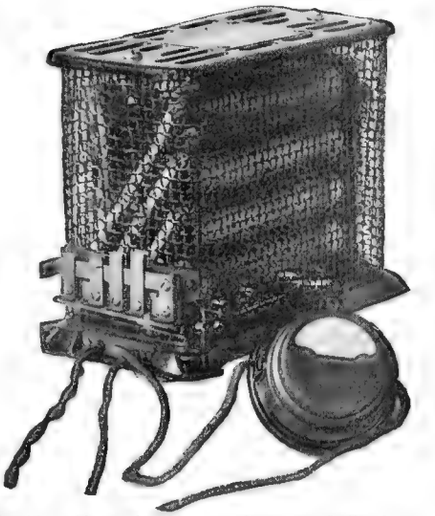
Alternating Current Telegraph Sounder, Key and Step-Down Transformer. Operates by Plugging in On Any 110 Volt, 60 Cycle A.C. Lighting Circuit.

In working two or more instruments on a line, polarity of impulses must correspond. If instruments work independently (with switches closed) but do not work together with the switches open, simply reverse one of the connecting blocks and they will respond properly.

When it is desired to operate two or more instruments on a line, the terminals are used for connecting the instruments in series: when used this way, the single point switches should be left open. Closing a switch localizes the instrument, so that it can be used for practise without interfering or being interfered with by other instruments on the line.

These alternating-current telegraph instruments are coming rapidly to the fore in commercial as well as private practise. They save the initial expense and the heavy maintenance cost of batteries.

NEW D. C. BATTERY CHARGING RHEOSTAT.



Do You Have to Charge Storage Cells from Direct Current Circuits? If So, You Will Find Extremely Valuable This Latest Battery Charging Rheostat and Ammeter. A Switch Varies the Current Strength.

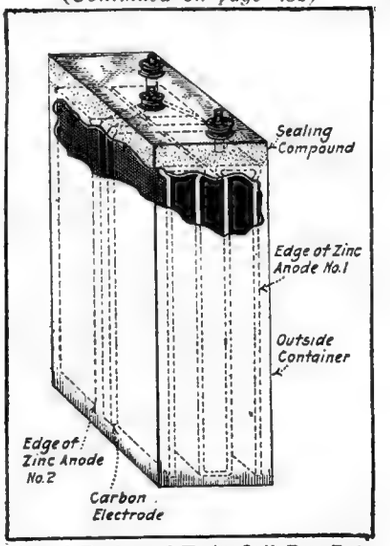
It is the purpose of this new charging rheostat to control the flow of direct current thru the battery, where the voltage of the charging circuit or line is much higher than that of the battery to be charged. This is done by means of a series of special high resistance coils made up in portable form, together with a current regulator switch giving charging rates of 1½, 3, 4½ or 6 amperes.

The voltage range of the rheostat takes in a single cell of battery up to 9 or 12 cells of 18 or 24 volts. The back pressure from a battery of higher voltage than this would cause a slight reduction in the ampere charging rates.

TWIN CELL DESIGN OF DRY BATTERY.

A new design of dry battery which is known as the "Twin Cell" is here illustrated. This design as shown in the illustration contains three electrodes, one positive flat carbon electrode, 7/16 in. thick by 1¾ in. wide, by 6 in. long, and two negative electrodes,

(*Continued on page* 481)



Novel Design of Twin-Cell Dry Battery. It Develops a Voltage of 1.5 to 1.55 Volts On Test and On Short-Circuit a Current of 35 Amperes.

Recording Your Chauffeur's Joy Rides

By Thomas Reed

MY neighbor, Theophilus Marbleback, had a chauffeur named "William," which innocent-sounding name was camouflage for a most guileful nature. "Circumstantial evidence" indicated that he was much addicted to joy-riding, and "Marbleback" desired me to invent an instrument for recording, unknown to "William," the moments devoted to this practise. He said that keeping tabs on the speedometer register was useless. That usually reliable instrument recorded only sorrows, not joys, for "William" deftly disconnected it during his mirthful moments. He didn't disconnect the gasoline bill, which came in at the end of the month robust and hearty, showing (if you integrated it only with the legitimate journeyings) a mysterious mileage of about five to the gallon; but apart from that, he was a busy and efficient little disconnector, and I was advised that my detecting device had better not depend upon the car's mechanism in any way, or it would be sure to reverse the excellent principle of the cascaret, and *sleep while "William" workt.*

Whether You, Mr. and Mrs. Reader, Possess One of Those Necessary 20th Century Gas-Hounds—"A Chauffeur"—You Will Surely Be Interested in Mr. Reed's Latest Panacea for Autoists' Worries. It Comprises a Silent, Invisible Detective, or Better, a "Recording Jogometer." A Clockwork Rotates the Paper Dial—and a Joggling Weight on a Spring Does the Recording. A Needle Jabs the Paper Dial Now and Then as the Car Rolls Along. No Motion—no Joggle, and no Records. Selah.

THE CHAUFFEUR'S "DETECTIVE" UNDER THE SEAT

"Marbleback" had a grand theory that if he could once get the goods on "William"—show them to him all registered up on some neat mechanism that would appeal to his fancy—the faithless "gas-hound" would be touched with repentance and mend his punctured conduct. Of course it was a perfectly chimerical idea, because the only result of touching a chauffeur is to make him leave you and go jumping off over the landscape looking for another car-owner who is sane and normal, and will stand for the things he has to stand for. Still, the problem interested me by its very difficulty. You know, if you have a certain amount of success in dealing with relatively simple things like high-frequency currents, you get sort of cocky, and feel like tackling a really complex and baffling job like putting something over on a chauffeur. So I took the matter under advisement.

Falling into the glassy-eyed and muttering condition common to inventors, my reflections were about as follows: "H-m, recording-thing got to move whenever car's going. What'll move it? Can't use gas-explosions, spark-discharges, rotation of wheels; 'William' put kibosh; must be concealed from 'William.' What other motive-power inseparable from car in motion? Aha, rush of air! Nix. 'William' spot anemometer, stick match in works. Oh, hum. What? Say, that's the system—the joggle! Some joggle always present, even on smoothest roads. Pervades every part of car. Hidden joggle-recorder what's wanted. A 'jogometer'—how's that?"

Fig. 1 shows the *recording jogometer* complete. It's an auto-clock in a locked box of strong "William"-resisting material (3-inch armor late will do) attached immovably inside the tonneau, or caboose, or whatever you call that part of the car where the passengers sit. The clock has no hands, but the hour-arbor is adapted to carry a paper dial, printed with time-divisions, which can be changed by unscrewing the nut N. The hand-gears must be altered so that the dial will revolve once in 24 hours instead of the usual 12.

Poised over the dial is the weight WT, attached to the end of a thin flat spring, free to vibrate between the dial and the stop placed just above. The lower side of the weight is sharpened off into a point, which embosses the paper dial as the weight drums upon it under the influence of the car's vibration.

Now then, let's conduct "William" thru a sample day, and see how it works. Look at the short line of dots "A" between 8.15 and 9 a. m. That's "Marbleback" riding down to his office on a bright sunny morning, full of hope and "pep."

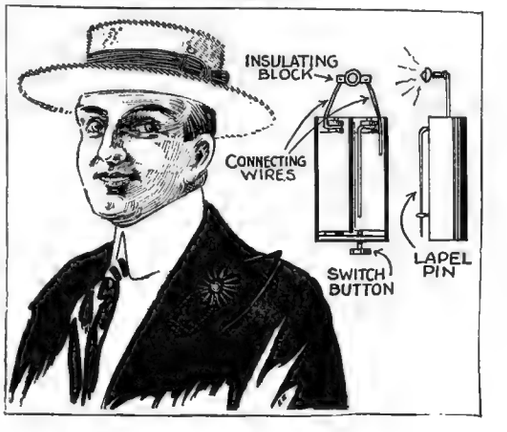
"B," from 11 to 2, shows Mrs. Marbleback shopping among the stores and beauty-parlors, flitting like a bee from flower to flower, so busily that the line appears continuous, and releasing with each fairy touch a little bill, which wings its way toward "Marbleback's" office.

At 2 o'clock ("C") she goes to the matinee, and the car is quiet till 4.30 ("D"), when she takes a turn around the park to see if any fashions have escaped her, calls for "Marbleback," and brings him home before he can "contract" any poker-games or leg-show stare, arriving at 5.30.

Now sound the "creepy music," for here is where the sleuthing starts. On the day in question, the "Marblebacks" past the evening at home, and from the point "D" onward, the record should have been a blank. But what do we see? the telltale arcs "D," "E," "F," "G," and "H," which betray "William's" nocturnal society life! Naughty, naughty "William," we are onto you! At "D," after an hour in the garage to make sure of dismissal, you were riding home to supper. Snatching a hasty meal, you hied yourself at 7.30 ("E") to the home of your blonde enchantress—Sadie Spasm, coffee-pusher and near-movie-queen. But from 8.45 onward ("F") whither, oh whither tends this hour's continuous journey, while Sadie leans back on the silken cushions, with all the inside lights lit, rehearsing "Theda Bara" on her way to the Duke's warehouse after another keg of pearl necklaces? Whither, prithee, but to the Rat's-Nest Inn, hospitable home of the joyous jazz, 40 short miles adown the pike. That blank till 1 a. m. means soup on the tablecloth at Childs' tomorrow, "William," beans for the gent who ordered "ham and," and for you a "head," a grouch, and perchance the can; but what boots it when youth and beauty drive? At "G" the relentless *jogometer* pictures "Theda" returning with the keg and "William" with the jag, and at "H" the car garage-ward plods its weary way. Selah!

A Button-Hole Flashlight

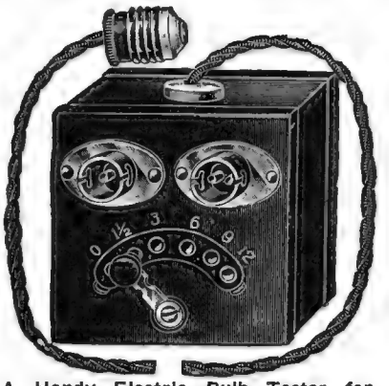
One of the latest innovations in the always convenient and invaluable electric flashlight is the one here illustrated, which fits in your coat lapel. A patent was recently issued to Mr. Edwin Frank Thomas of Meriden, Conn., on this extremely small model flashlight, which operates on a specially built and very compact style of dry battery. The casing holding the battery is fitted with a lapel pin of the same form as that used on brooches and other jewelry, enabling the wearer to easily attach the flashlight to the coal lapel or other garment. The lamp is turned on and off when desired by a simple turning of the switch button fitted in the bottom of the battery casing. The battery is a two-cell unit, and current is carried to the miniature incandescent lamp thru the supporting wires in the manner apparent.



Try These on Your Auto

AUTO BULB-TESTING DEVICE.

A new electrical automobile lamp-testing device is here shown. The tester is designed for all sizes of auto electric lights



A Handy Electric Bulb Tester for Private or Dealer's Use.

fitted with Ediswan bases. When a dealer sells an electric light bulb, he can test it before the customer's eyes, showing that the bulb is good and obviating any dispute afterward when the purchaser puts it in his car and happens to burn out the bulb thru some fault of his own.

PUSH THE BUTTON AND GET YOUR "GAS."

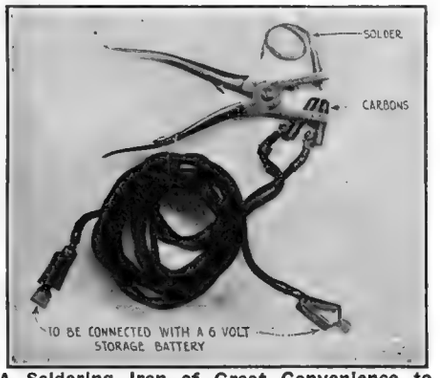
In the accompanying illustration an electrically operated outfit is shown which is intended for use in garages and service stations for pumping gasoline. This outfit is electrically operated, and is controlled by a push-button switch. The electrical control is arranged so that when the push-button is deprest, the pump continuously discharges gasoline at the rate of 25 gallons a minute, or may be reduced to a mere drip. When the button is released, the pumping stops automatically. The rate of flow is regulated by a speed control handle. The electric motor provided is enclosed in a strong iron case which is impervious to moisture or gases, permitting the outfit to be located out of doors. A large filter is built into the outfit to remove water and foreign matter which may be in the gasoline.

I Want 5 Gallons of "Gas." Alright, Deposit Your Coin, Push the Button and Get Your Gas.

A NOVEL 6-VOLT SOLDERING TOOL

This new soldering tool, which has recently been patented, embodies some features never before employed in an electric soldering device, its inventor claims. The one shown in the photograph is made to be attached to a 6-volt storage battery. It can even be attached to the storage battery in an automobile, or on ordinary lighting voltages in connection with a step-down transformer.

All of the heat is applied at the exact point where it is needed, and just for the instant needed, so it does not require one-tenth of the electrical energy that is used by other soldering irons of equal capacity. One of the features which appeals to the user is that it is always ready for instant use; no waiting to heat up the tool before it can be used. Wire can be soldered together in less than 10 seconds; it is not only soldered but sweated right in.



A Soldering Iron of Great Convenience to Autoists. It Works on a 6 Volt Storage Battery.

This soldering tool is light and simple in construction and the solder is always ready for instant use, as it is carried in the tool.

YOU CAN LOOK RIGHT INTO THIS BATTERY

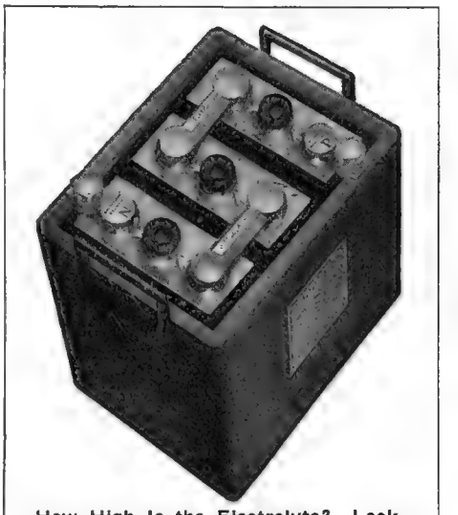
No one would think of buying or living in a light-tight, windowless house. Windows in a storage battery are just as essential. Every battery user will easily recognize the importance of knowing the exact condition of his plates and separators and the quantity of electrolyte in the battery at any moment. This great improvement in storage battery design makes it possible to know always what is going on inside your battery.

In the ordinary storage battery each cell has a hard rubber cover, and when the cells are sealed into their case the only possible view of the interior is thru the small vent hole in the cover. No satisfactory index to the condition of the vital parts can be obtained in this limited way.

The new storage battery here illustrated has a strong transparent cover on each cell. This window is actually stronger than the hard rubber used on other batteries, so there is even less danger of breakage. It is not affected by acid, and the tops and connections can be more readily kept clean and free from corrosion.

The solution, or electrolyte, in a storage battery must always be kept about ¼ inch (but no more) above the tops of the plates. Under no circumstances should the plates be allowed to project above the liquid.

Peep thru the window in this battery and



How High Is the Electrolyte? Look in the Window and See.

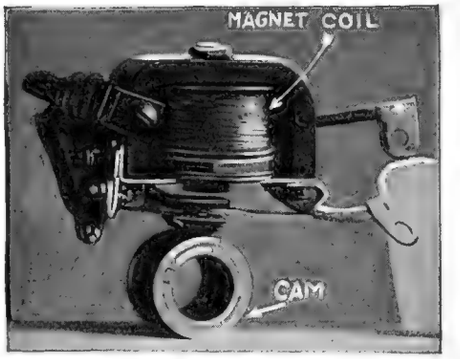
two red arrows will be seen projecting inward from the terminal posts. These indicate the exact level to which the electrolyte should rise in the cell.

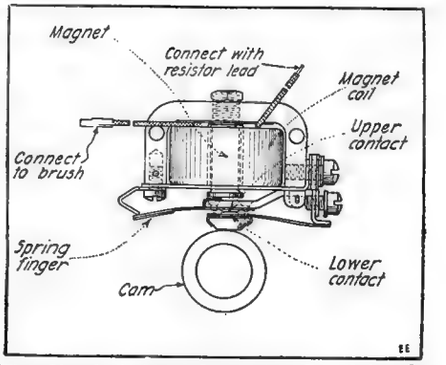
A NEW CAM REGULATOR FOR AUTO DYNAMOS.

By William H. Easton.

Every automobile electric generator must have some means for keeping its voltage fairly constant under all normal operating conditions. Without such a device, the voltage would vary with every change in the speed of the engine and every alteration in the load of the generator and the current generated would be useless for either lighting or battery charging.

(*Continued on page* 483)



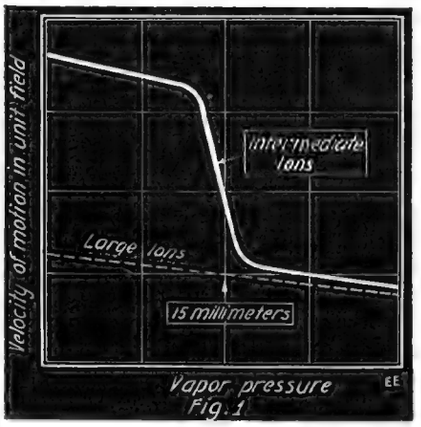


The Simplest Auto Generator Regulator for Maintaining Constant Voltage—a Magnetic —Cam device. Can Be Used With or Without Storage Battery.

The Mystery of Atmospheric Electricity

By ROGERS D. RUSK, M. A.
Late of the Meteorological Section, U. S. Army Signal Corps.

THE air is in a continual state of electrification because it contains at all times small particles charged with electricity. Even the scientists themselves do not know just what these particles consist of because they are different from the electrified particles found



This Curve Shows Clearly How the "Intermediate" Ions of the Air Change Their Velocity Like Magic at 15 Millimeters Vapor Pressure, and Become "Large" Ions. An Interesting Discussion on This Phenomena Is Here Presented.

anywhere else. We are seldom aware of the existence of these particles because of their very small size and due to the further fact that all bodies at or near the surface of the earth *are at practically the same potential as the earth.* However, if all the electricity in the air could be collected for use at one time, there would be more, by far, than we would know what to do with. Benjamin Franklin startled the scientists of his day by bringing lightning down on a kite string, but we can go him one better today.

ELECTRICITY OUT OF A CLEAR SKY.

Even on the clearest day, if we send a kite up a few thousand feet, a distinct difference of potential can be noticed between the ends of the kite wire, often enough to give a severe shock. The cause of this electrification has been the subject of much discussion, but the biggest problem is to find just what these minute charged particles consist of.

Ions or small particles charged with electricity can easily be produced in most any gas by means of an electrical discharge or by the influence of X-rays or radium, but the ions found in the air are different from these; in fact, they are different from those found anywhere else, hence it is that they present a puzzling problem to the scientist. In general there are three types of ions which are found in the atmosphere called the *large, small and intermediate.* The small ones which have been known to exist for a long time are the same as those produced in any gas by the means above mentioned. When either an electric discharge, X-rays or radium rays causes an electron or element of electricity to be detached from an atom or molecule to which it belongs, then it leaves that atom or molecule charged with the same amount of electricity of the *opposite* sign, and the charged particle is called an *ion.* Sometimes these particles group themselves together, thus forming ions of larger size. Instead of these,

The Physics of Nature's Electricity Simply Explained

however, there are still larger ions found in the air which could hardly be formed from even large groups of small ions, for reasons to be mentioned later.

The larger ions of the air and the intermediate ones are closely related and are the ones which so far are puzzling the scientists. Aitken, whose work along this line is justly famous, believes that the larger ions of the air are not aggregations of smaller ions, because when the smaller ions are formed by radium in a dust-free gas, the larger ions never appear. For this reason he believes the larger ions are really *dust particles* which have caught a charge of electricity. The word dust, however, is a convenient word to cover up our ignorance of just what the large ions actually are. In fact, they exhibit some properties which make them very interesting, and which show that they are far from being simple particles of dust.

October Number of the Electrical Experimenter

A New American Salvaging Machine with which hundreds of vessels sunk during the World War will be raised. A description with elaborate illustrations, prepared by an engineer who walked on the bottom of Long Island Sound in this marvelous machine, by Joseph H. Kraus.

Do Radio Waves Produce Sparks in and Ignite the Gas in Balloons and Dirigibles? This question is answered by an Electrical Expert of high standing.

Sun Spots and the Observatory That Photographed Them—an especially interesting article, by Isabel M. Lewis, of the U.S. Naval Observatory.

Treasure Ships Located by Electricity, by H. Gernsback.

Making a Machine for Telegraphing Pictures—Part 2, by Leroy J. Leishman, Telephotographic Expert.

Investigating Psychical Phenomena with Scientific Instruments, by Hereward Carrington, Ph.D.

"Jerry Up," a thrilling tale by an American searchlight electrician who served in France, by Charles K. Fankhauser, Jr.

Radio Problems in Aviation, by Edward Rice Doyle, late Lieutenant U. S. Army Air Service, U. S. A.

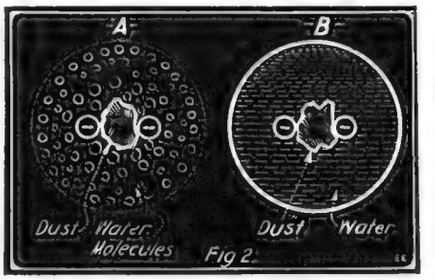
Magnetic Storms—how sunset, wind and other weather phenomena actually cause "magnetic storms," by Prof. Lindley M. Pyle, Department of Physics, Washington University.

How Science Applies the X-ray to Numerous Industrial Problems.

Electric Automobile to Compete with Gas-Driven Vehicles, written by its designer, Harry E. Dey, E.E.

WHAT ARE ATMOSPHERIC "DUST" PARTICLES?

These *dust particles,* if they are such, must not be confused with ordinary wind dust particles such as those blown up from a street. They are much finer and smaller, so much so in fact that they are capable of remaining suspended in the air for a very long time. Such particles are too small to be detected by ordinary means of observa-



A.—An Intermediate Air Ion Consisting of Negatively Charged "Dust Particle" Surrounded by Dense Atmosphere of Water Molecules.
B.—A Large Ion Formed by Water Vapor Condensing to a Liquid About the "Dust Particle."

tion and they can best be observed and counted by the famous *cloud method.* This method is to take a sample of the air and put it under reduced pressure which allows it to expand until the moisture in the air begins to collect around the *dust nuclei,* making them visible. In determining the relative size of the original particles another method must be used, and that is to compare their *mobilities. The mobility of an ion is its rate of motion in an electric field of one volt per centimeter, and is a measure of its mass.* The larger the mass the slower the particle will move under the given force.

By this method the larger ions are found to be *over a thousand times larger than the small ions and the intermediate ions about half way between.* It is argued that if these were *dust particles* only, then all sizes would be found instead of *three* distinct types. Recent discoveries tend to show there is something more than dust and electricity in the large ions and that it is this something else which causes the formation of the large ions which are not found anywhere else. It is all due to the discovery, a few years ago, that water vapor may condense in two ways on a rigid surface under certain conditions. Either it may condense in the ordinary way as a pure liquid, or it may condense more slowly and form a very dense atmosphere of separate water molecules about half way between a gas and a liquid, which will suddenly change to a liquid with an increase of the vapor pressure.

Now the significant thing is that if the mobilities of the ions are measured carefully while the pressure of the water vapor in the gas is being increased, a point is reached where the intermediate ions suddenly begin to move slowly like the large ions as shown in Fig. I, and this has suggested to J. A. Pollock and others the following explanation: The larger ions and the intermediate ones are formed of minute, rigid dust-like particles about which a small amount of water vapor has already started to condense. About some of these

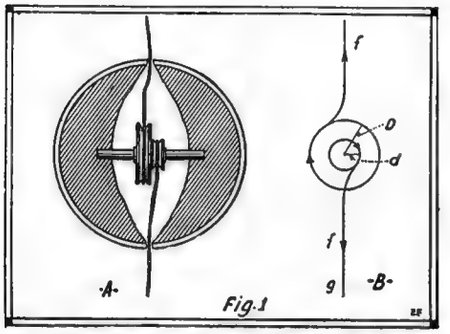
(*Continued on page* 473)

Experiments in Physics

By JOHN J. FURIA, A. M.
DEPARTMENT OF PHYSICS, N. Y. UNIVERSITY

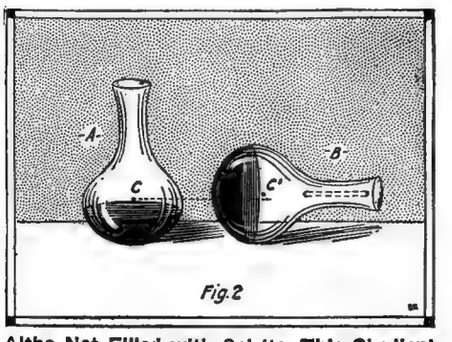
2--Illusions

PRACTICALLY all of the so-called "illusions" that are brought before the public, whether on the stage, at private entertainments, or sometimes in swindles, are based on fundamentals of physics. Hence it is fitting in a series of articles on "Experiments in Physics" to deal with this topic. Illusions may be divided into four classes: (1) Optical, (2) mechanical, (3) chemical, and (4) slight-of-hand. The first two types are of especial interest to us from the standpoint of pure physics.



The "Obedient Ball" and How It Is Made from a Wooden Crochet Ball Hollowed Out as Shown. In This Space Are Placed Two Small Silk Spools with Strings Attached. The Ball Rises or Falls on the String at Command.

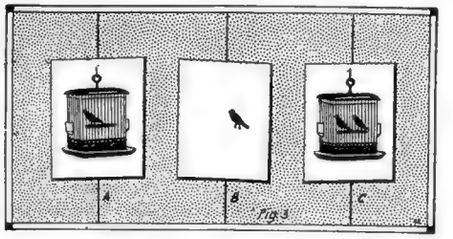
Perhaps the most mysterious of the magician's tricks, and one which appeals to all boys, is the *obedient ball.* All ball players appreciate the value of an obedient ball, especially the kind of ball that will "come to papa." As usually presented to the public from the stage the magician passes a piece of string thru the center of a good sized wood ball and then holds the string vertical. At his command the ball slides up the string, down the string, or else remains stationary. The *obedient ball* can be easily made at practically no cost. Divide a crochet ball in half by the use of a very fine saw. Carve out enough of the insides so as to have enough room for two small silk spools to revolve freely, see figure (1) A. The spools are glued together and fastened to the inside of the crochet ball by a dowel rod used as an axle. String is wound around each of the spools and the ends led out thru holes at the end of a diameter of the ball, perpendicular to the axle. The ball is glued together, sandpapered, stained and shellacked, and if a good job is made of it no one will suspect that the ball has been cut open.



Altho Not Filled with Spirits, This Obedient Bottle Will Lie Down and Stay Down Only for Its Master—the Magician. How Does It Work? Read on!

Figure (1) B explains why the ball will rise, fall or stand perfectly still. If the string is held loosely, the ball will fall, due to the pull of *gravity* on it. As force is applied to the ends of the string, gradually a point will be reached where the force of gravity is just overcome by the advantage gained by pulling the upper string (since the diameter of the spool to which the upper string is attached is larger than the diameter of the spool to which the lower string is attached). Greater force will cause the ball to move upward. It should be noticed that as one spool winds the other unwinds in each of the cases where the ball rises or falls. Hence the total length of the string in view changes according to the difference in the diameters of the spools. It remains for the performer to detract the attention of his audience away from this fact. The illusion is one of pure physics, more particularly mechanics. The equation for the motion may be written as follows:

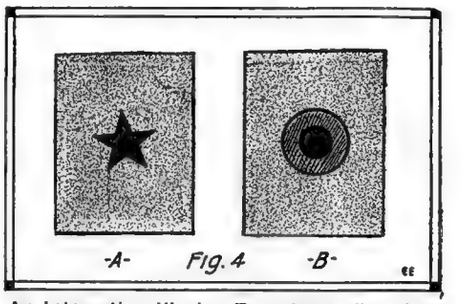
Let g represent the force of gravity, f the force applied to the string by the performer, and D and d, respectively, the diameters of the spools. $Df - d(g + f)$ causes the motion. When f is zero (when the performer holds the string loosely) the tendency to move upward (Df) is zero and tendency to move downward is dg, and the ball moves downward. When f is such that $Df = d(g + f)$, the tendency to move upward equals that to move downward,



If Two Cards Are Drawn to Resemble Figures A and B, Placed Back to Back on a Cord and Then Spun Rapidly, Two Birds Will Appear in the Cage, as at C.

and the ball remains stationary. When f is large enough so that Df is greater than $d(g + f)$, the tendency to move upward is greater than that to move downward, and the ball moves upward.

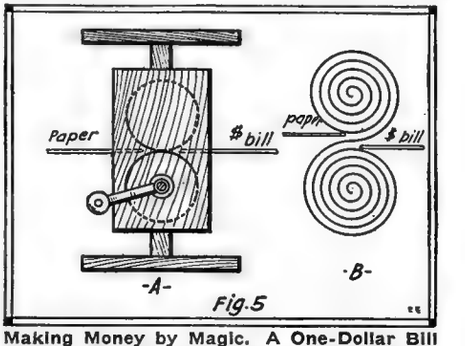
Speaking of the *obedient ball,* the event of July 1st (last) leads us naturally to the *obedient bottle.* A small wood bottle (empty since July 1st) of the shape indicated in figure (2) A, is placed on the table and told to "lie down—and stay down," and the bottle does so. (Nothing remarkable.) The performer then picks up the bottle and passes it around, defying anyone else to cause it to "lie down—and stay down"! No one is able to do so. The performer then takes the bottle again, coaxes it and causes it to lie down as before. This is another case of pure physics, more particularly mechanics. The bottle is weighted with lead as shown in figure (2) A, so that its center of gravity C is very low. It is seen from figure B, that placing the bottle on its side causes the center of gravity to be raised to the position c'. It is well known in mechanics that a body is in stable equilibrium (will return to the same position when displaced) when its center of gravity is at its lowest. Hence it follows that the bottle will always return to its stable equilibrium position (standing up). How, then, does the performer cause it to lie down. He keeps concealed up his sleeve or "palmed" a long narrow weight which he slips into the neck of the bottle whenever he wishes it to lie down. The addition of this long narrow weight causes the center of gravity for the upright position of the bottle to be high, so that placing the bottle on its side causes the center of gravity to be lowered; hence this will now be the position of stable equilibrium. In picking up the bottle before passing it to the audience for examination, the performer allows the weight to drop back into his hand again.



An Interesting Illusion Experiment Based on the Persistence of Vision. A Black Star Drawn on a Blank Card, When Spun Rapidly, Will Change Into Two Circles—One Gray and One Black.

In order not to disappoint those accustomed to "seeing double," the following is inserted for trial any time after July 1st. Draw a bird in a cage on one side of a blank card. On the *reverse* side draw another bird. Attach a piece of thread to the top and bottom of the card and twirl the card about this thread as an axis. TWO *birds will be seen in the cage.* Many variations of this illusion can be tried. The cage alone on one side and the bird on the other; a glass of "Bevo" on one side and an open mouth on the other, etc., etc. The result obtained is due to physiological rather than physical reasons. The phenomenon is known as *persistence of vision.* The retina of the eye retains any image thrown upon it for a moment after the object has been removed. Hence when

(*Continued on page* 479)



Making Money by Magic. A One-Dollar Bill Run In One Side of the Machine Comes Out a Ten-Dollar Bill, or a Piece of Paper Changes Into "Real Money." Ain't It Wonderful? Yes, It Is—NOT!

Practical Chemical Experiments

By ALBERT W. WILSDON

Cleaning and Washing Agents
Part II

WATER and a few other solvents are commonly used to remove dirt, sometimes called "matter out of place." Some of these substances readily dissolve in water; others like the fats, will dissolve in ether

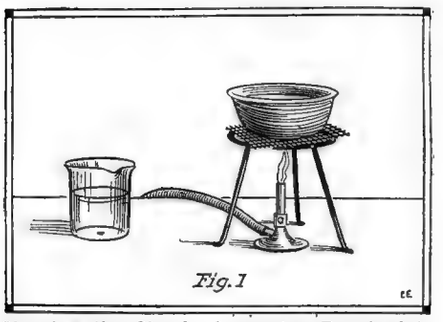


Fig. 1

Showing the Simple Apparatus Required to Perform Experiment No. 1. A Bunsen Burner, a Beaker, Tripod, Gauze and Heating Dish.

or gasoline; and still others, for instance the resins, will dissolve in alcohol. Some form of alkali, such as wood ashes, was formerly used with the water, to assist in removing the dirt. This, it was discovered, possest a very destructive action upon the goods, so a *saponified* fat, the product produced by the action of an alkali on a fat, or what we now call *soap,* came into universal use. This, as is well known, when made of good materials will not injure the goods. Soap was used instead of lye from the lixiviation of ashes, long before the chemistry of the process became known. It was not until 1813 that Chevreul publisht his scientific researches on the composition of fats and the processes of soap-making.

Manufacture of Soaps.

The raw materials used in the manufacture of soap are an alkali known as *caustic alkali,* which may be either sodium or potassium hydroxid. The sodium hydroxid will produce a hard soap, while the potassium hydroxid produces a soft soap. These are made by boiling the carbonat with slaked lime, following out the equation

Sodium Carbonat + Calcium Hydroxid = Calcium Carbonat + Sodium Hydroxid.

From this mixture the calcium carbonat settles out, and the solution of the caustic alkali is boiled down to a solid, and is put upon the market under the name of *concentrated lye,* or the concentrated solution is used directly by the soap-maker.

Recently the caustic soda has been made directly by the electrolysis of sodium chlorid. The sodium deposited at one pole is dissolved in water, and the chlorin is used for making bleaching powder.

The second ingredient of a soap is either a vegetable or animal fat or oil, or a resin. Such oils as that of the palm nut, cocoanut,

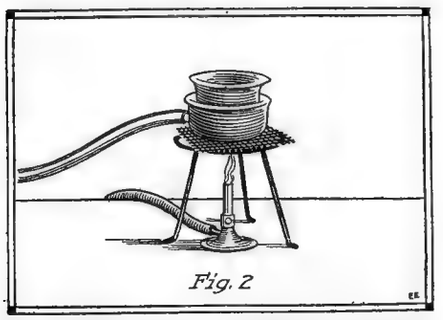


Fig. 2

How Evaporation Is Effected on the Water Bath of the Solution Obtained from Experiment No. 1. Apparatus Shown Is Used in Experiment No. 2.

olive, hemp seed, linseed, cotton seed, fish or lard may be used, and fats like beef tallow, mutton tallow, lard, or house grease.

The process of *saponification* may be occasioned either by the action of water or steam at high temperatures and pressure (especially in the presence of a dilute mineral acid), by the action of caustic alkalies, or sometimes by the use of lime. The fats may be briefly described as consisting of ethers of the triatomic alcohol-radical, containing *glycyl.* By treatment with alkalies or high-pressure steam, they yield *glycyl alcohol* (glycerin) and stearic or other fatty acid. The name given to the compound of the acid and glycerin is *stearin, palmitin,* or *olein.* In the case of stearin, the equation representing the saponification would be:

$$\underset{\text{Stearin}}{C_3H_5(C_{18}H_{35}O_2)_3} + \underset{\substack{\text{Caustic}\\\text{Potash}}}{3KOH} = \underset{\text{Glycerin}}{C_3H_5(OH)_3} + \underset{\text{Soap}}{3KC_{18}H_{25}O_2}$$

With palmitin or olein, the reaction is similar. If the fat or oil is solid, it contains a preponderance of stearin or palmitin, but if liquid, there is an excess of olein.

In making soap on a large scale, a kettle, provided with both a closed and open steam coil, so that the soap may be boiled either by the heat or the free steam, is used. A

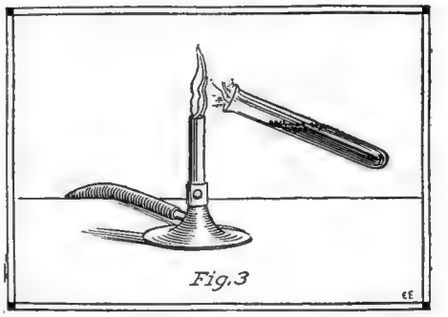


Fig. 3

Applying the "Sodium Test" in the Flame of a Bunsen Burner. Experiment No. 4.

kettle that will hold 100,000 pounds of soap is 15 feet in diameter and 21 feet high, and is made of ⅜ inch boiler plate. The melted fat and lye are run into the kettle and mixed by the aid of free steam and boiled for some time, or until the soap has a dry, firm feel between the fingers; it is then *salted out* by adding common salt. In boiling, the saponification represented in the above equation has taken place, and when the salt is added this causes the soap to separate from the caustic lye and glycerin. After boiling, to mix thoroly, the mass is permitted to stand in the kettle till the soap rises to the top, and then the lye may be drawn off at the bottom of the kettle. Some more strong lye is then added, and the boiling is continued till the material is fully saponified, which the experienced soap boiler knows by sight, feel, and taste, and then the content of the kettle is again allowed to stand for a while, and the additional lye is drawn off. The soap is then boiled with some water, and is permitted to settle again, to allow the separation of more alkali, dirt and impurities, called *nigre.* After standing several days, the soap is pumped into the *crutcher* which consists of a broad, vertical screw working within a cylinder, which is placed in a larger tank. Here it is thoroly mixed, and any perfume or scouring material may be added. The soap is then drawn off into rectangular *frames,* holding about 1000 pounds where it is allowed to solidify. The sides of these frames are removed and the

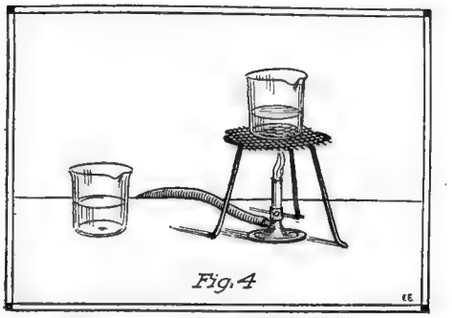


Fig. 4

Simple Apparatus Used in the Preparation of "Prussian Blue," as Described in Experiment No. 5.

soap is cut, by means of wire, into slabs and then into bars. If put on the market in the form of cakes, the bars are prest into the desired shape.

For making white soaps, tallow, palm oil, and cocoanut oil are used. Castile soap, if genuine, is made from olive oil, sometimes with the addition of cocoanut or rape seed oil. It is useless to attempt to make a good soap out of an inferior material. In making lower grades of soaps, cheaper fats are used, and frequently those that have a rancid odor. This is sometimes *corrected* by the addition of a strong perfume, like oil of *mirbane,*—nitrobenzine, made from coal tar. Yellow soaps almost always contain considerable rosin; that is they are made by the usual process, except that quite a large proportion of rosin replaces the fat. This has valuable soap-making qualities, and would not be classified as an adulterant of soap. Cocoanut oil saponifies without boiling, so it is used in making the *cold process* soap. This material also admits of the use of a larger quantity of water, so that the soap will be hard and still contain as much as 70 per cent of water. Soap is mottled by stirring into it, while warm, some coloring substance, such as copperas, ultramarin, or an anilin color.

Sand soap, pumice stone, and compounds of a similar character are made by incorporating sand or powdered pumice, with the ground soap, and this ought to lessen the price of the soap very materially. These substances can act only mechanically; that is they *sandpaper off the dirt.* A silicated soap is made by mixing with the ordinary soap some silicat of soda or

(*Continued on page* 475)

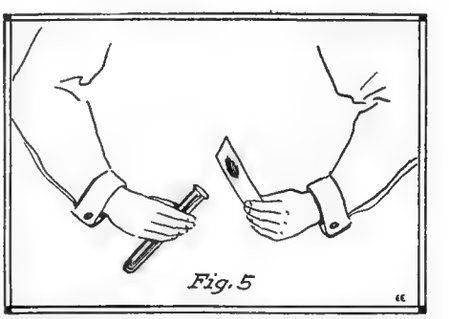
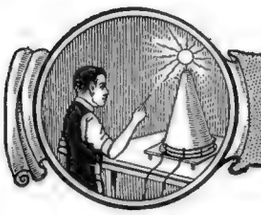
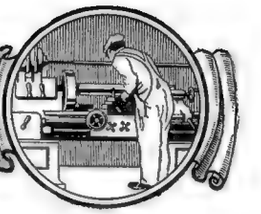


Fig. 5

Holding a Piece of Paper Moistened with Lead Acetate and Permitting the Gases to Act Upon It, Showing the Presence of Hydrogen Sulfid. Experiment No. 7.



THE CONSTRUCTOR



Thermo-Electricity Experiments

By THOMAS W. BENSON

IT was first noted by Seebeck, of Berlin, that when a juncture of dissimilar metals was heated a current of electricity would flow. This phenomena was studied by Cumming, Sturgeon, Pellaci and many others, for it gave promise of providing a means for *developing electricity direct from heat, without the use of steam engines and generators.*

Altho no practical application has been made of the discovery, beyond its application to *pyrometry* for heat measurements, several interesting devices can be easily constructed to demonstrate the phenomena.

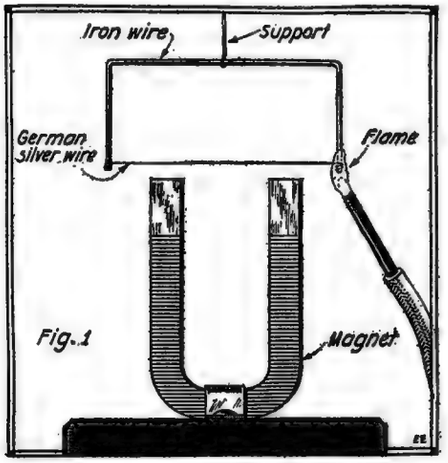
The most powerful currents are generated by heating junctures of the more crystalline metals, such as antimony and bismuth, the other metals lying between these in regard to the strength of the current generated with a given rise in temperature. The following list gives the thermo-electric order of the more common metals:

+Bismuth	Tin	Zinc
Platinum	Gold	Iron
Mercury	Silver	—Antimony
Lead	Copper	

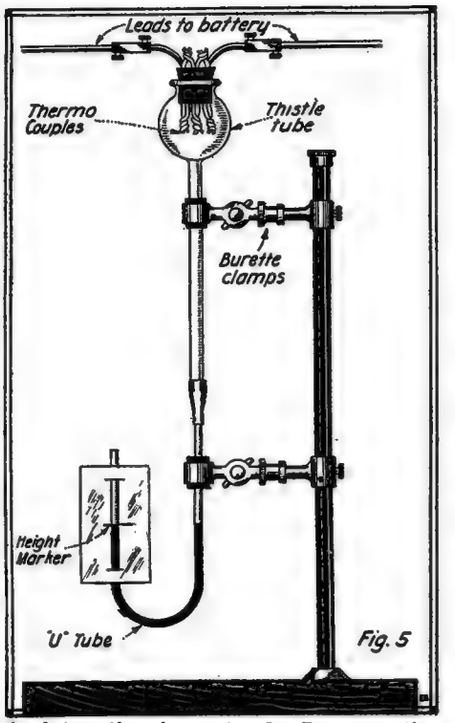
Any two of these metals when joined together and the junction heated results in a current flowing thru the exterior circuit from the metal highest on the list to that lower. The *reverse* is true should the junction be cooled. The further apart the metals are in the table the greater will be the electromotive force.

It is seen that bismuth and antimony will give a so-called "couple" having the highest E.M.F. These are rather difficult to obtain and handle, so for experimental purposes we will substitute iron and German-silver wire. These two metals are employed in the construction of thermo-couples for electric pyrometers, and will serve our purpose admirably.

The electro-dynamic effect of *heat generated* currents can be shown by a device similar to that illustrated in Fig. 1. Three sides of the wire rectangle are composed of iron, the fourth of German-silver. The frame is suspended over a permanent magnet and heat applied to one corner as shown. The frame will turn thru an angle of 90° due to the currents flowing in the loop.



The Electro-Dynamic Effect of Heat Generated Currents Can Be Shown by the Simple Device Here Illustrated. An Iron and German Silver Wire Rectangle Is Suspended Above a Magnet. The Loop Turns When Heated.



An Interesting Apparatus for Demonstrating the "Peltier Effect," or the Production of "Cold" by Electricity.

A large number of turns of wire could be made to form a *heat compass.* The details of such a device are shown in Fig. 2. A small bundle of soft iron wire is bound with paper glued into place. Take a number of lengths of iron and German-silver wire and wrap them in the same direction on the core, in alternate coils as shown. Twist the ends of the wire together so that every other joint is on top. The ends of the more distant coils being connected together by a loop of wire, thus forming a sling to support the compass.

When this apparatus is suspended over a hot copper or brass plate, the currents flowing around the windings will cause it to act as a *compass* and the core will place its axis in a line with the natural magnetic field of the earth.

A form of *thermo-electric motor* can be constructed as shown in Fig. 3, to demonstrate electro-magnetic rotation. Here we have a ring of iron wire attached to which are a number of vertical German-silver wires, bent over at the top and joined at the center to a pivot. The latter rests in a tiny depression in the pole of a horseshoe magnet, allowing the cage to turn freely.

By applying a small flame to the frame at the juncture of the G.S. and iron wires between the legs of the magnet a current will flow thru the vertical wires and rotation will result from *magnetic repulsion.* The device will attain quite a high speed if carefully constructed.

A thermo-battery can be cheaply made that will deliver a fairly heavy current in the following manner: Take a 1" pine board 6" square and drill with small holes at the intersection of lines drawn in both directions ¼" apart. The board is then impregnated by placing in melted paraffin. Alternate 2" lengths of iron and G.S. wire are pushed into the holes and their ends tightly twisted together on both sides of the board, the end wires being led to binding posts.

When the battery is stood with one side in the sun, the other being shaded, an appreciable E.M.F. will be generated. **If laid on a block of ice in the sun it will ring a vibrating bell!**

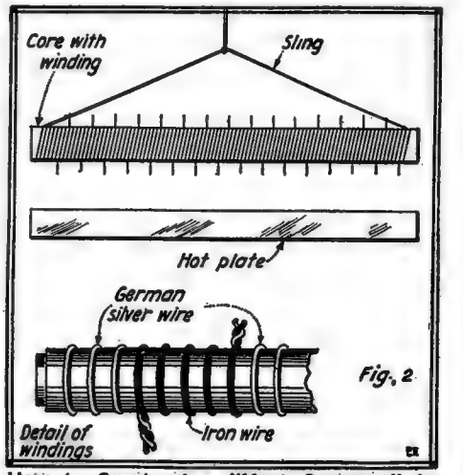
A somewhat similar form of *thermo-pile,* comprising antimony and bismuth bars, in the hands of Forbes and Milloni led to the beautiful discovery of the polarization of heat.

Andrews noted that a current was generated when platinum wires are inserted in a bead of fused borax, potassium chlorid, chlorids of potassium and strontium, iodid of potassium, sulfate of soda, and even when boracic acid is used. These results, however, are due to a *thermo-chemical* action and formed the basis for the work of Edison and others on the *heat cells.* The action differs from the *true* thermic action of dissimilar metals.

Conversely we have electro-thermic effects whereby heat and cold result from an electric current passing between dissimilar metals. The production of cold by this means is rather startling and is known as the *Peltier* effect.

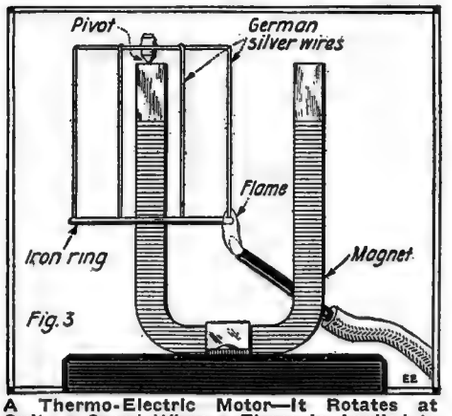
Apparatus to demonstrate the latter effect can be assembled as shown in Fig. 5. A large thistle tube has connected to its lower end a U-tube with a small bore, by means of a length of rubber tubing. The U-tube is partly filled with colored water.

A cork that fits the mouth of the thistle tube has six holes bored thru it into which



How to Construct a "Heat Compass," by Winding Turns of Iron and German Silver Wire About an Iron Wire Core. In Use It Is Suspended Above a Hot Brass Plate.

are inserted short lengths of iron and G.S. wire, about five strands of wire being put in each hole. These are twisted together to form thermo-couples and the cork inserted in the mouth of the thistle tube. A little paraffin wax melted over the cork will seal the whole effectively.



A Thermo-Electric Motor—It Rotates at Quite a Speed When a Flame Is Applied to the Armature, Made Up of Iron and German Silver Wires. A Most Interesting and Little Known Device.

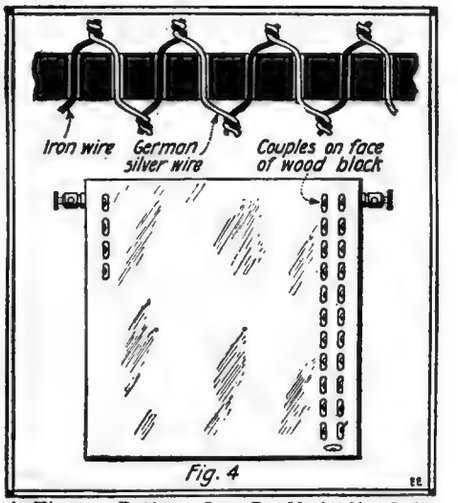
When the positive and negative poles of a battery (gravity type preferred) are connected to the iron and G.S. wire respectively, the junctures inside the tube will drop in temperature and the air contracting will cause the water in the open leg of the U-tube to drop. For best results the current should be regulated by a rheostat so that it is not sufficient to heat the wire used in the couples.

A current having a fairly high E.M.F. and low amperage gives the best results.

The exact cause of the current generated in a thermo-couple is still an unsolved problem. It is not due to any oxidization or chemical effect for it has been found that a bar of the same metal with different temperature of its opposite ends will give a slight current, the cold portions becoming *negative*, the hot parts *positive*. A thoro understanding of the phenomena demands more complete knowledge of matter structure and the inter-atomic forces.

A fuller realization of the forces in action may revolutionize present methods of current generation and perhaps refrigeration.

Thus there is a very fine field open for experimentation by the industrious student. By experiment we learn many things heretofore undreamt of.



A Thermo-Battery Can Be Made U. Quite Cheaply by Mounting Iron-German Silver Wire Couples on a Board as Shown. Laid on a Block of Ice in the Sun, It Will Ring a Bell.

A "Selective" Electrolier Switch

By Albert H. Beiler

The writer recently tried to make an electrolier switch which could control from one to five lamps. The lamps were on a chandelier and it was undesirable to turn each lamp on or off at its socket. They were placed on the chandelier as shown in Fig. 1. Owing to the fact that it was desired to make the lamps light in a symmetrical arrangement, it was not necessary to control each lamp singly, but merely to get a switch which could light one, two, three, four or five in a *symmetrical order*.

Number of Lamps	Number of Each Lamp	Control Circuit
1	3	B
2	1, 5	A
	2, 4	C
3	1, 3, 5	A, B
	2, 3, 4	B, C
4	1, 2, 4, 5	A, C
5	1, 2, 3, 4, 5	A, B, C

For example, if two were desired, it would not look well to light one and four, or two and three, but a combination like one and five, or two and four would do nicely. Accordingly, the wiring to the lamps was arranged as shown in Fig. 2. With this wiring the circuits would have to be controlled as summarized in the table above.

There is thus a common wire going directly from one main to one terminal of each lamp and three control wires which go to the *selector switch*. This switch is constructed as described below.

Secure a piece of hard wood 5 x 5 x ⅞ inches. Lay out a hexagon of 3 inches diameter, as shown in Fig. 4. Drill ⅜-inch holes at the eight points indicated about ¼ inch deep. The seven numbered holes should have small holes go clear thru the wood and just large enough to permit a No. 14 wire to pass thru (No. 50 drill). The unnumbered hole is a blank whose purpose will become apparent later. Twist some bare No. 14 wire into little spirals, as shown at 3A, and put one in each of the seven numbered holes so that the end passes out thru the bottom. Then stop up the small holes where the wires protrude with sealing wax, so that each ⅜-inch hole is a sort of liquid-tight cup with a conductor lying along its bottom. The wiring is shown in Fig. 3 running to four binding posts, which had best be labeled as indicated in India ink to avoid confusion later. The base may now be chamfered and stained to make it look well. The holes should then be connected by the lines shown and the triangle so formed should be labeled as indicated in Fig. 4.

The bridging arms should now be made. These are two triangular pieces of ⅜-inch fiber or hard rubber, the triangles measuring 2 inches on a side (Fig. 5). The holes are drilled ¼ inch from each vertex, and are tapt to receive 8-32 machine screws. A ⅞-inch machine screw is put into each hole at a vertex. These three screws are then connected to each other by No. 16 wire twisted around each and neatly forced into grooves, scratched into the fiber for the purpose by a sharp awl or scriber. A small porcelain knob is fastened to each triangle by a washer and screw fitting into the center hole.

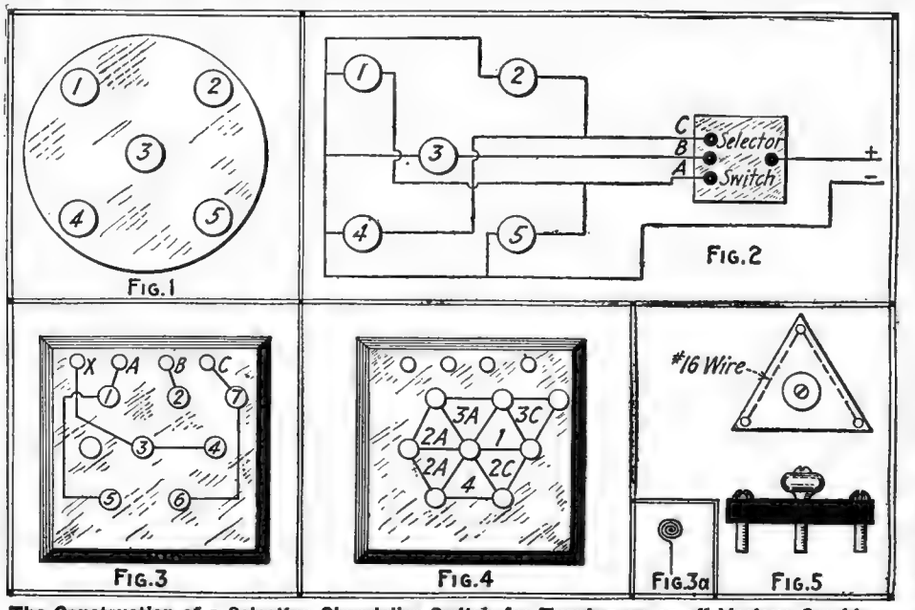
If the triangles are constructed properly each will fit into any three holes at the vertices of an equilateral triangle in the baseboard. The numbered holes should then be filled with mercury to about 3/16 inch from the top. Binding posts A, B and C are connected to control wires A, B and C, and the common wires goes to the other side of the main (Fig. 2).

It is obvious then that any combination noted in the table may be obtained by covering the triangle whose number indicates the number of lights to be lit. For example, to light *four* lamps, one of the triangles is placed in holes 3, 5, 6, so as to cover triangle No. 4, etc. Up to and including four lamps, only one triangle need be used, but for five a combination like 2A and 3C or 4 and 3C is needed, requiring two triangles.

The arc formed when a triangle is lifted out is inappreciable, being broken simultaneously at two places. Should it be desired, however, to break a circuit carrying more than about 5 amperes, it will be better to construct a base of fiber.

This switch may be made at a cost of about 25c, whereas an electrolier switch of commercial manufacture to satisfy this wiring costs upwards of $4.00.

Many modifications of this novel switch can be worked out with a little ingenuity on the part of the builder. This switch lends itself well to many laboratory circuit requirements.



The Construction of a Selective Chandelier Switch for Turning on or off Various Combinations of Lamps, Is Here Described by Mr. Beiler. Special Arrangements for Larger Groups of Lamps Can Be Worked Out Easily.

Making a Machine for Telegraphing Pictures

Part I

By LE ROY J. LEISHMAN

Expert In Telephotography

IT is a very simple matter to *telegraph pictures*. A crude machine for this purpose was suggested seventy years ago. The idea is therefore not entirely new to students of electricity, but the science has been so neglected that it is still nebulous to the average person.

How little the general public knows of *telephotography* is shown by the fact that when two of my machines were exhibited on the Orpheum and Pantage's vaudeville circuits two years ago, the demonstration was fascinating, baffling and uncanny to the audiences everywhere. Even most of the newspapers had never heard of such a thing before.

A person with an electric picture transmission machine may therefore entertain and baffle his friends and townspeople, besides conducting a great deal of experimenting which will be instructive and highly beneficial to himself.

By the time this article appears, popular interest in telephotography will be heightened by the use of telegraphed pictures by many of America's leading newspapers. Several papers have already publisht "news pictures" periodically, *and pictures have been telegraphed across the continent at regular intervals and displayed on bulletins.* The practicability of the scheme is shown by the fact that excellent pictures have been transmitted 4,856 miles! Many newspapers have recently subscribed for a service that will supply one hundred and fifty news pictures a year, *making it possible for them to publish a picture of an event the day it happens, regardless of geographical location or distance!*

So the person with the necessary apparatus to telegraph pictures will find himself the center of interest everywhere.

It has often seemed puzzling to me why more electrical students have not experimented with telephotography. Many letters which I have received lead me to believe it may be due to a popular misconception that such experiments are too costly. I therefore recently designed some *Picture Telegraphing Instruments* which are low-priced enough to suit every experimenter who may be interested. To further interest the readers of this magazine in this fascinating and instructive field, I am explaining in this article how a simple telephotographic set can easily be made. However, the chief fascination and instruction is in the operation of the finished machines and in the various experiments that can be made with them.

No exact dimensions will be given for any of the various parts, as the material at one's disposal sometimes makes it advisable to change some of them; and then the others must be altered accordingly.

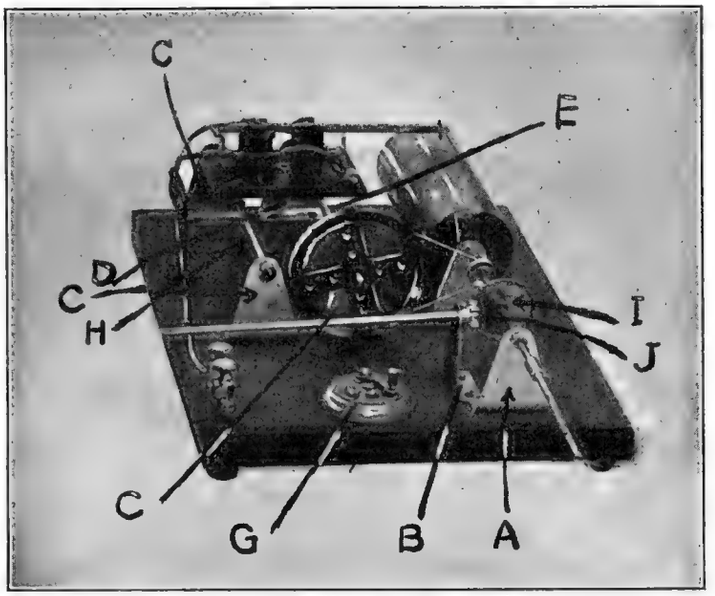


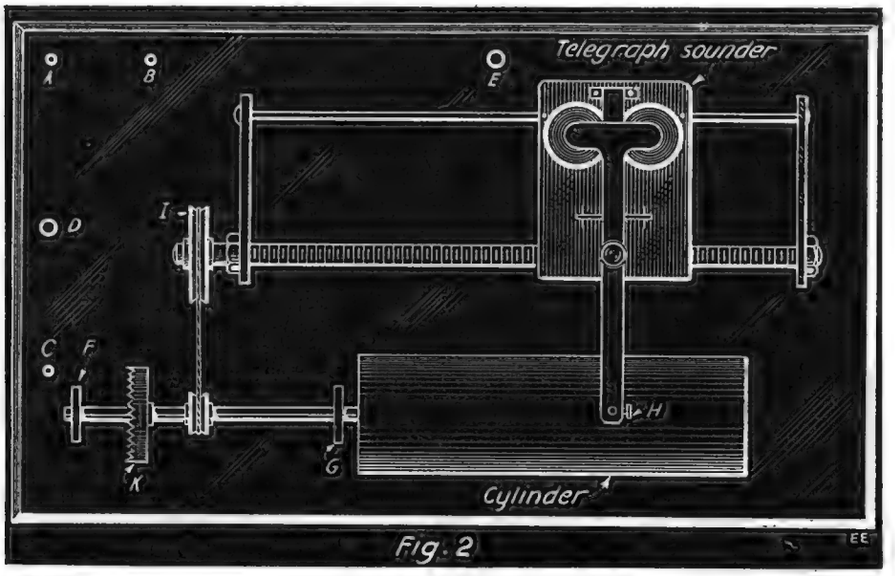
Fig. 1.—The Telephotographic Machine Here Described. It Opens up a New Era in Scientific Experiments for the Electro-mechanical Student and Provides a Stepping Stone to this Newest Branch of Applied Science.

GENERAL DESIGN FEATURES OF APPARATUS

Let us first get an idea of the general appearance of the device we are going to make. A glance at figures 1 and 2 will show that the machine resembles very much an old style cylinder phonograph. The cylinder of the picture transmitting machine holds the pictures to be telegraphed in the same manner that the phonograph cylinder holds the record to be played. The sending and receiving carriage corresponds with the phonograph reproducer, and it passes slowly from one end of the cylinder to the other on a threaded shaft as the cylinder revolves. In this manner the carriage needle finally touches every part of the picture. The threaded shaft on which the carriage travels *must* be absolutely parallel to the cylinder. The reproducer on a cylinder phonograph has a half nut that rests against the threaded shaft, so that the reproducer may be lifted up and moved to the other end of the cylinder. This necessitates another shaft, parallel to the threaded one, on which the reproducer pivots. A picture transmitting machine is similarly equipt.

The size of the complete apparatus depends upon the dimensions of the pictures to be telegraphed, as this determines the size of the cylinder; and the shafts and base must be proportioned accordingly. A convenient size for the picture is about 5 by 6 inches. As plenty of margin must be allowed, this necessitates a cylinder about 2 inches in diameter and 5½ inches or 6 inches long. Electrical contact must be made with the rolled copper plate which is slipt on the cylinder, so it is most convenient to make the cylinder from metal tubing. Ordinary pipe will not do, as the cylinder must be very true and perfectly uniform thruout. Brass or nickel-plated fixture tubing is excellent. A metal bar or disc must be soldered in each end, and holes *accurately drilled* in the *exact centers* to fit the shaft. As the cylinder is light and supports no great weight, the shaft may have a small diameter, so a rod can be selected for this purpose which will fit the gears available. Erector, Meccano or other rods are satisfactory, and can easily be fitted with gears which are obtainable in the regular sets or at any hardware store. The cylinder rod should be 3 or 4 inches longer than the cylinder and must be *perfectly straight.* Place it thru the holes in the cylinder ends and solder it so that one end is flush with one end of the cylinder.

After the cylinders have been made, the length of the base can be decided upon, as this dimension should exceed that from one end of the cylinder to the other end



Top View of Telephotographic Machine Here Described in Detail. The Parts Required in Building it Are Few and Simple, But Should Be Made with as Great an Accuracy as Possible.

(*Continued on page* 446)

Home-Made Compound Microscope

By Carl F. Muckenhoupt

A COMPOUND miscroscope is beyond the reach of many experimenters because of its prohibitive price. Since such an instrument is very useful, and desired by many experimenters, I describe below the theory of the microscope, and the method of building one cheaply.

Fig. 1 shows how the tiny object OP is enlarged by the objective at O'P', which image in turn is re-magnified by the eye-piece, and seen as at O"P". To avoid complexity, only the rays from the head of the little arrow are shown, but rays from the other end would pass symmetrically oppo-

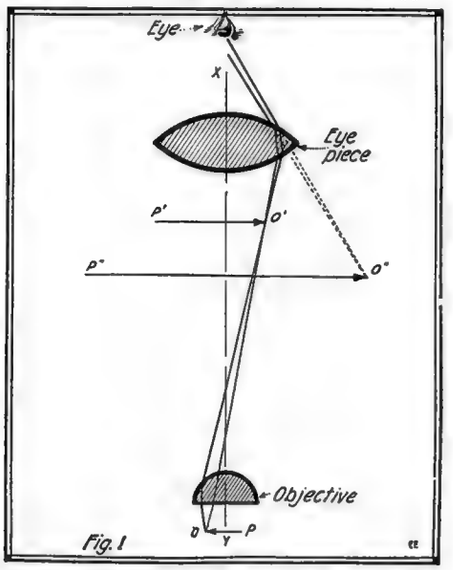


Fig. 1. This Diagram Shows the Path of the Focal Rays Thru the Optical or Lens System of the Home-Made Compound Microscope Here Described and Illustrated. The Eye-Piece Lens Shown Is a Double Convex One, While the Objective Lens Is of the Plane-Convex Type. Most Good Microscopes Have Two Lenses In the Eye-Piece.

site the main axis XY, and come to final focus at P", just as those shown focus at O". We see that by placing the object just outside the focus of the short-focus lens, an enlarged image is cast at some distance, which in turn is magnified by the eye lens. A good microscope has two lenses in the eye-piece, instead of one, to make a field free from chromatic and spherical aberration.

A good microscope is shown at Fig. 2. The tubes are preferably of thin sheet metal, rolled over a stick to the proper diameter, and then soldered. They may, however, be made of pasteboard. The main

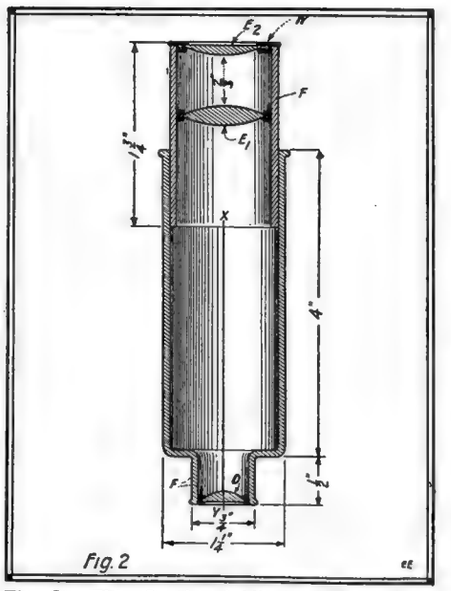


Fig. 2. This Sectional View of the Microscope Shows How the Metal Tubes of Brass, Copper, or Other Covering Are Arranged to Slide Within One Another; the Objective Lens Being Placed at O, and the Two Image-Magnifying Eye-Piece Lenses at E-1 and E-2.

tube is 4 inches long by 1¼ inches in diameter. A ring is soldered to its bottom end, with a ¾ inch hole in it. In this, in turn, the little objective tube, ½ inch long by ¾ inch diameter, is soldered. Make sure everything is well soldered, and then paint the inside of the whole affair a dull black, *not* shiny black. For the eye-piece, make a tube 1¾ inches long, and of a diameter to fit the main barrel snugly. This may take some time, for it must not work too tightly, or be too loose. Paint this black inside as well.

Power	Focal length of E_1 and E_2	Distance between E_1 and E_2	Distance between O and E_1
50	$2\frac{2}{3}$ inches	$1\frac{7}{9}$ inches	$6\frac{1}{3}$ inches
75	$1\frac{2}{3}$ inches	$1\frac{1}{9}$ inches	$5\frac{1}{3}$ inches
100	$1\frac{1}{4}$ inches	$\frac{5}{6}$ inch	$5\frac{1}{8}$ inches
130	$\frac{8}{3}$ inch	$\frac{9}{16}$ inch	$4\frac{7}{8}$ inches
		Note: For low powers the eye piece tube is very long	

Data for eye pieces for various powers; the letters are those of Fig. 2. E_1 is always double, and E_2 is always plano convex.

The lenses naturally come next. O, the objective, is a ½ inch focal length, *plano-convex* lens. These can be secured from your optician. E_1 is a 1-inch focus, double convex lens. E_2 is a 1-inch focus, plano-convex lens. Take care to have these last two of the same kind of glass. O is mounted by making a ring to fit the bottom of the objective tube, and with a hole slightly smaller than the ½ inch focus lens. Center the lens over the aperture as shown, and glue a ring of felt F, with a hole smaller (slightly) than the lens, to the metal ring. When fast, clean the lens thoroly, and solder carefully to the little objective tube as shown by Fig. 2.

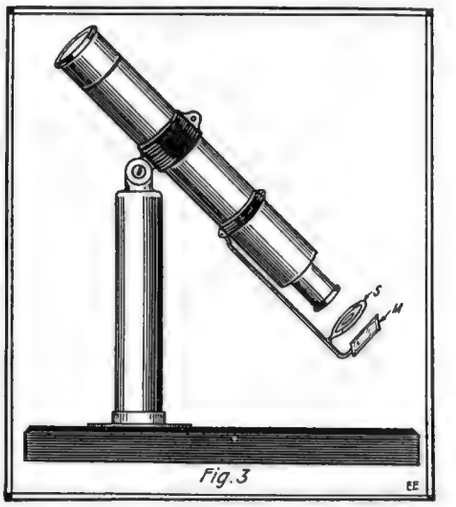


Fig. 3. A Simple Arrangement for the Home-Made Microscope Which May Be Modified and Improved by the Ingenuity of the Constructor, by Adding a Rack and Pinion or Other Precision Focusing Gear.

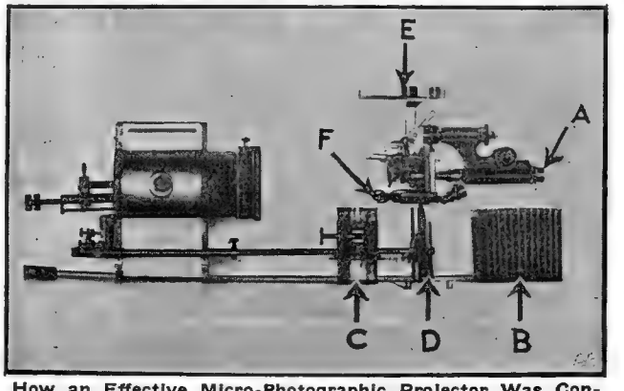
In one end of the eye-piece tube, fasten a ring of wood W, with a hole smaller than the plano 1 inch focus. Cut out the wood until the lens fits well, then screw a cap on the end with an aperture of about ½ inch. Mount E_1 2/3 of an inch from E_2, by forcing a ring in the tube, at right angles to it, and gluing felt around the lens. Push the eye-piece in until E_1 is about 4⅝ inches from O. This need not be exact unless you want to know the power exactly. The objective should be about 9/64 inch from object, which must be brightly illuminated. This distance nced not be exact either. If both distances are exact, the power is 112.

Any one can devise his own stand, or use the scheme shown in illustration Fig. 3.

A Micro-Photographic Projector

The ease with which this apparatus is constructed is its main feature, provided, of course, one has the microscope and an ordinary projection lantern. I will proceed to the explanation of the letters in the picture.

Remove the entire front combination of lenses C, and the bellows, B. Bend the tube of the microscope, on the hinge provided, until it is at right angles to the foot E. Turn upside down and fasten to the front support D by two ordinary small wood clamps. Remove the eye-piece A, and you have a most excellent projector. It is much more satisfactory if one has a sub-stage condenser as shown in the photograph.



How an Effective Micro-Photographic Projector Was Constructed from a Stereopticon and a Microscope.

This unique arrangement of physical laboratory apparatus should find a great many uses, especially among lecturers and teachers, who find it necessary to enlarge or throw on a screen micro-photographic views of minute organisms, et cetera. Either an electric arc or incandescent lamp may serve as a source of light or else an acetylene light. Careful focusing of the complete apparatus is necessary to obtain a clear image on the screen. Drawings are often made in this way of minute objects by projecting them on white paper.

I have used this apparatus for class-room work and for making pictures of microscopic objects with fine satisfaction.

Contributed by E. K. GIFFEN.

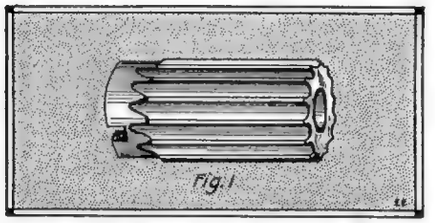
Experimental Mechanics

By SAMUEL D. COHEN

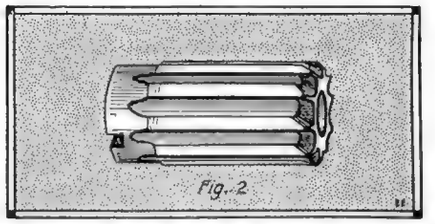
LESSON XIV

REAMERS CONTINUED.

IN order to save the material which would be used for the shank, the shell reamer having a hole thru its center by means of which it is mounted on the arbor, is largely used. By making the reamer in this manner *one* arbor can be utilized for a number of sizes. The general appearance of a shell reamer is illustrated in Fig. 1. This type is known as a *fluted shell* reamer. In Fig. 2 a *rose shell* reamer is shown. The cutting edges, fluting, and back taper of this latter type are the same as those of the rose reamers. However, in all other particulars, the tool is the same as an ordinary fluted shell reamer.

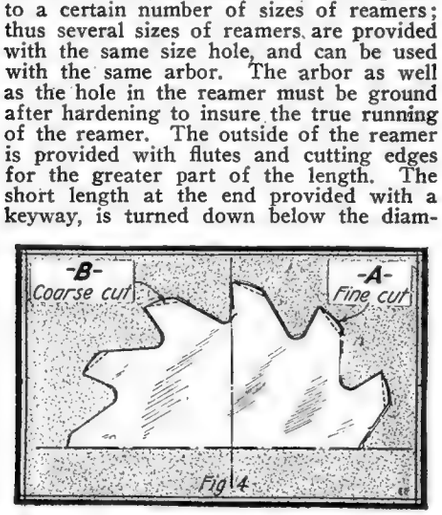


The Shell Reamer—This Form Is Widely Used in All Machine Shop Work. It Is Used on an Arbor.



A Typical Rose Shell Reamer. This Tool Has a Cutting Edge Provided on the End of Each Tooth as Shown.

The arbor used with the shell reamer is shown in Fig. 3, the shell reamer being provided with a keyway, which freely fits the key B. The reamer, when at work, is rotated by means of this key and keyway. The hole thru the reamer tapers, the taper being ⅛ inch per foot. Manufacturers of reamers have adopted certain standard sizes of arbors, and each arbor corresponds to a certain number of sizes of reamers; thus several sizes of reamers are provided with the same size hole, and can be used with the same arbor. The arbor as well as the hole in the reamer must be ground after hardening to insure the true running of the reamer. The outside of the reamer is provided with flutes and cutting edges for the greater part of the length. The short length at the end provided with a keyway, is turned down below the diameter of the cutting edges. This is done to prevent any burr which may be set up by the driving key on the arbor from interfering with the hole being reamed or disfiguring the cutting edges of the reamer.



Showing Two Ways of Grinding Reamer Teeth.

The fluted shell reamer type as shown in Fig. 1, is provided with a greater number of flutes for the same size than are ordinary fluted chucking reamers, because the flutes must be shallow on account of the hole thru the reamer. The flutes are cut, however, with the same kind of fluting cutters as are used for reamers generally. The corners at the end of the fluted shell reamer are slightly rounded.

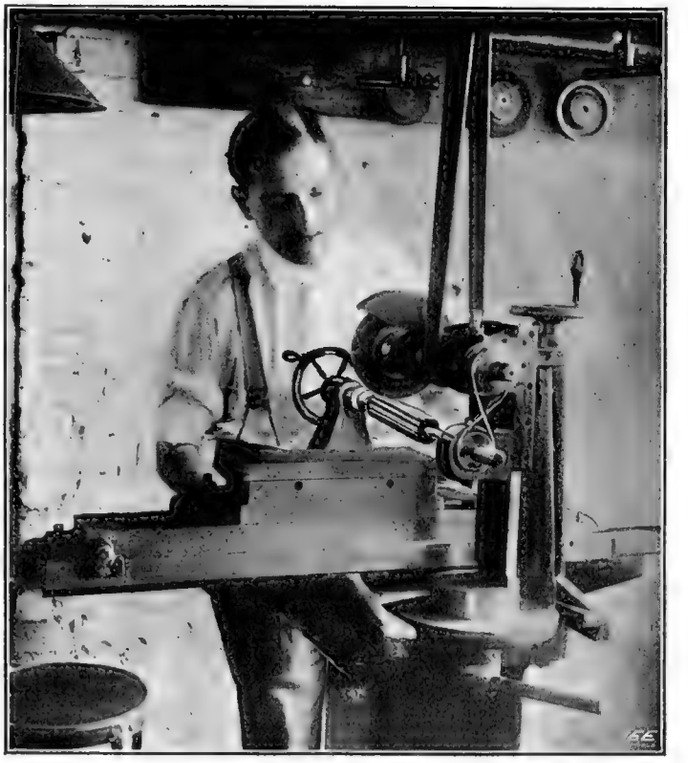


Fig. 5. Reamers Are Usually Ground to Final Size on a Precision Grinding Machine of the Type Here Shown. With Such a Machine the Reamer Can be Ground to Any Taper Desired with an Accuracy of One-Ten Thousandth of an Inch.

The arbor used for driving shell reamers consists of a stem or arbor proper C, as illustrated in Fig. 3, provided with a collar D, fastened to the arbor by means of a taper pin. A tongue B is milled at the end of this collar, which constitutes the key fitting the keyway in the reamer. Precaution should be taken during the "milling process" to ascertain the exact centering of the tongue in the collar. Care should also be exercised in milling the keyway in the reamer. When grinding the outside of the reamer to size, this work should be done on an arbor similar to that on which it is to be used. The arbor as well as the driving collar should preferably be made from tool steel and the collars should be hardened. The arbor as generally manufactured, is made in fourteen sizes, the diameter of each being measured at E, half-way between the end of the key and the solid part of the body of the collar, D. The arbor has a flat milled on the shank for the set screw by which it is clamped and held in position in the machine where it is used.

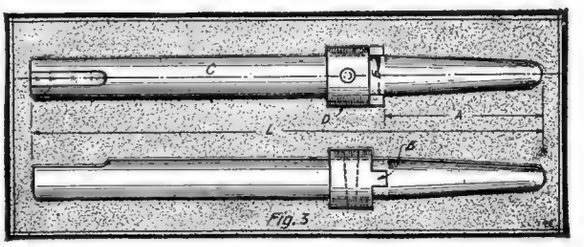
Too great or too little clearance on the teeth of a reamer will tend to produce unsatisfactory results, the first invariably causing the reamer to wear to a greater extent, as the shavings get in between the cutting edges and the work to be reamed, thus slowly grinding away the cutting edges. Also there is a tendency to bind the reamer in the hole, consequently injuring the hole as well as the reamer, and causing more exertion in performing the reaming operation.

The Steel Arbor Used for "Driving" Shell Reamers Consists of a Stem C, Provided with a Collar D, Fastened to the Arbor by Means of a Taper Pin. A Key or Tongue B Is Milled on the Collar to Hold the Reamer.

The *flat relief* or *clearance*, altho mostly used, is not the most desirable, because the cutting edge is not properly supported. Best results are obtained by a clearance, as shown in Fig. 4. The difference between this clearance or relief and the flat is obvious from the illustration, where the relief is shown by dotted lines "B." It is usually termed the *eccentric relief*, and its use is strongly recommended, as it adds greatly to the capacity of the reamer for producing a smooth hole. The relief is produced by placing the reamer in a grinding machine as usual, not on centers in line with the spindle, but on auxiliary centers provided with adjustable side ways, so as to enable them to be set at different positions for different relief required on various sizes and kinds of reamers. The reamer is thus held eccentrically. A rocking motion is then imparted to the spindles holding the auxiliary centers, and in this manner, the grinding wheel traveling back and forth along the reamer, will produce an eccentric relief.

The eccentric relief, however, is not in

(*Continued on page* 438)



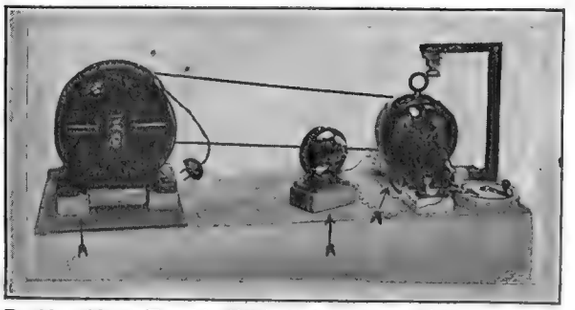
HOW-TO-MAKE-IT

This department will award the following monthly prizes: First Prize, $3.00; Second Prize, $2.00; Third Prize, $1.00.
The purpose of this department is to stimulate experimenters towards accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department, a monthly series of prizes will be awarded. For the best idea submitted a prize of $3.00 is awarded; for the second best idea a $2.00 prize, and for the third best prize of $1.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $3.00

MOTOR AND GENERATOR SILENCER.

In carrying on experiments in electricity and having only 110 volts alternating current at my disposal, I recently added a



Do You Have Trouble With Noisy Motors? Eliminate It! Mount the Offending Machine on Sponge Rubber As Indicated by the Arrows.

motor-generator set to my equipment. As my experiments were necessarily performed at night, due to work in the daytime and having due consideration not to annoy the people on the opposite side of the house at late hours with the humming of a motor and dynamo, the selection of a quiet running piece of apparatus became of prime importance.

A high grade, 6 volt, 6 ampere dynamo was obtained which proved reasonably quiet, but when firmly secured to a 1½-inch board with a one-eighth horsepower motor likewise mounted, driving it, the noise was quite offensive. Most small motors of the alternating current type are very quiet when well bolted onto a concrete or iron foundation, but when mounted on a wooden plank 1½x12x30 inches it is another story. The first motor of 1,750 R.P.M. type was very good, but a little too noisy, and by obtaining a similar machine running at but 1,140 R.P.M., the noise was cut down fully two-thirds.

Of course, these results were encouraging, but my progress was still retarded by the noise made which I knew was not good to put "kids" to sleep by.

It finally occurred to me to use some soft silencer such as cork or rubber, and after numerous experiments with everything I could think of, I was finally successful. For the ⅛ H.P. 1,140 R.P.M. motor I secured three pieces of regular *art gum* from a 10 cent store. These blocks of soft "rubber" measured exactly 1x2x3 inches. They were mounted with LePage's glue to both the base of the motor and dynamo, and when placed on the board, the two machines could be operated with an exceedingly tight belt tension with no "walking" of the apparatus, even after hours of operation.

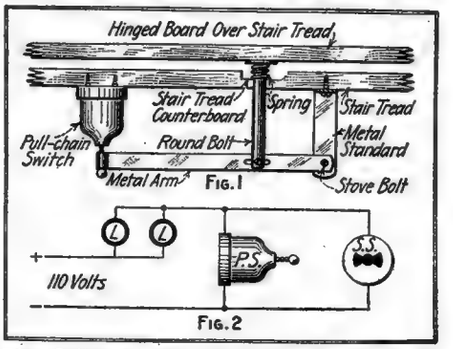
Contributed by C. V. TURNER.

[*Editorial Note—Those having noisy phonograph motors will find it efficacious to mount the feet of the motor on art gum or "sponge rubber." Tests have shown excellent results.*]

SECOND PRIZE, $2.00

CONTROLLING THE CELLAR LIGHTS.

The arrangement with which this is accomplished is shown in Fig. 1. A pull-chain switch of proper size to handle the lamps on the circuit is mounted on the *under surface* of the uppermost stair tread. The chain is shortened to an inch or so, and is attached to a metal arm pivoted on a metal standard which is screwed to the tread a short distance from the switch. At a point near the standard the metal arm is slotted to take a small stove bolt which fastens the slotted round bolt movably to it. This bolt passes thru a hole in the tread which is also counterbored to allow the bolt head to lie flush when the coiled spring under it is fully deprest. A board cut to the same size as the tread should be hinged to the riser above it so that the board will lie flat against the top of tread when stept upon. Coiled springs should be placed between the two at each end, to keep the front edge of the board separated about half inch or so from top of tread. This is all that is necessary as the small movement of bolt is increased by the leverage of the metal arm. The action of the device is obvious. As the top board is trod upon, it is deprest, moving the bolt downward against its spring, which movement is amplified and communicated to the pull-chain of switch by the metal arm, thus turning the switch "on." When weight is released, the board and other parts return to their original positions. When the board is again trod upon, the action is repeated, this time turning the switch "off." No dimensions are given as the sizes of the various parts will vary according to the size of switch and



The Cellar Lights Are Turned on and off Automatically by This Stair-Tread Switch Wrinkle. The Moving Tread Is Attached as Shown to a Pull-Chain Socket.

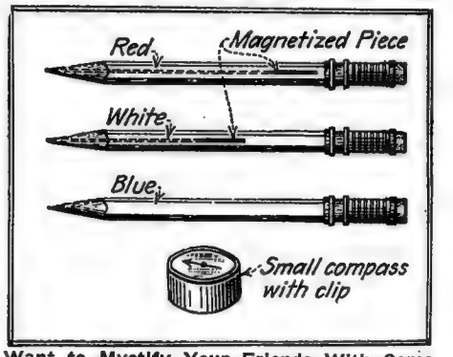
other conditions. As it is sometimes desired to leave the lights (LL) "on" while repeatedly passing up and down the steps it will be well to install a snap switch (SS) in the usual position and connect it in multiple with the pull-chain switch (PS) as depicted in diagram Fig. 2.

Contributed by J. A. WEVER.

THIRD PRIZE, $1.00

THREE MAGIC PENCILS—A MAGNETIC HOAX.

EFFECT: Three colored lead pencils are given out for examination, red, white and blue, for example. The performer leaving



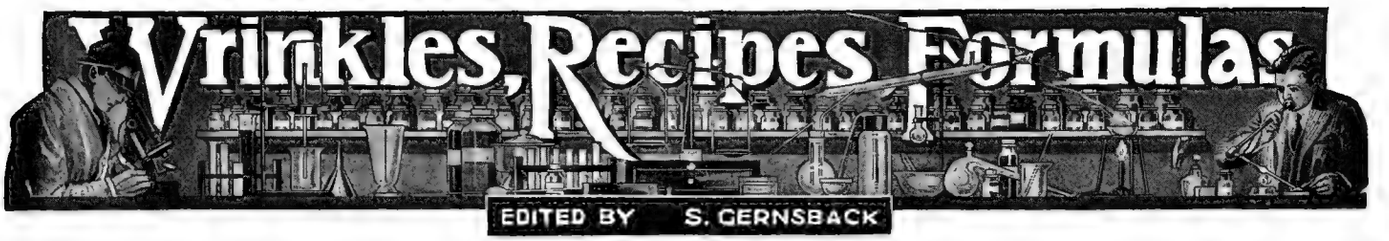
Want to Mystify Your Friends With Some Hindu Pencils? Here's How: With a Magnet Placed at Different Positions in Two or More Pencils, Conceal a Small Compass in Your Cuff. The Rest Is Easy—You Can Tell at Once Which Colored Pencil Is Inside an Envelope, Even Tho It Was Wrapt up While You Were Absent from the Room.

the roon. tells anyone to choose any color pencil they wish, while he is out of the room, and to wrap it up in any color piece of paper or cloth, and to hand it to him securely wrapt when he returns to the room. Upon receipt of same the performer passes hand over pencil and tells exact color.

SECRET: Two of the pencils are "faked" in this manner. One of them is drilled with a 1/16 inch drill in the rubber end about 1 inch, and the other one is drilled half-way down or in the middle. Two pieces of Stubb's drill rod, ½ inch long by 1/16 inch diameter, are hardened, magnetized and inserted in the drilled holes and a piece of lead is inserted after the magnetized pieces and are made flush with top of wood in rubber end of pencil, the rubber is placed on top and the trick is ready; the third pencil contains no fake whatever. In leaving the room the performer attaches to his shirt cuff, inside, a small compass (some of these compasses can be obtained as small as a dime, or even of less diameter), which aids him in detecting what pencil is wrapped up or concealed in the cloth or paper in this way: He slowly passes pencil in front of compass and watches needle until it quivers, which it will do when that part of pencil containing the magnetized steel passes needle. If the needle moves when the *end* of pencil is near it, the performer knows it is the *red* one. If it moves when near the *middle* of pencil, he knows it is the *white* one; if needle does not move, it must of course be the blue one. As the back of hand faces audience, the compass is invisible.

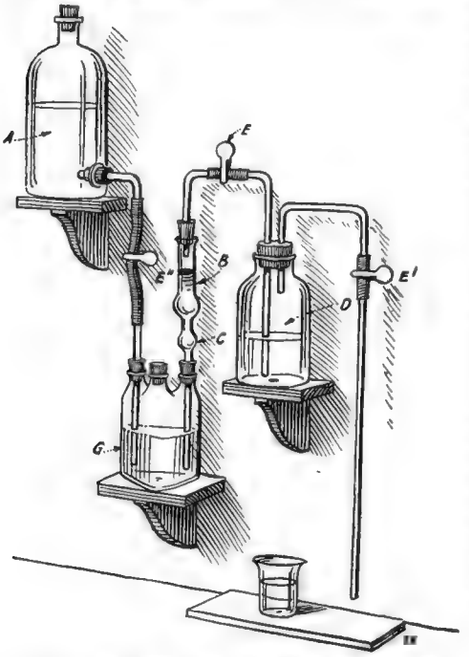
Many variations of this magnetic trick will suggest themselves to the wide-awake experimenter. Such as the magnetic "brass" ball—the inside of the ball is filled with iron filings and the small filling hole stopt up with brass.

Contributed by R. S. MYERS.



A NEW FORM OF HYDROGEN SULFID GENERATOR.

From time to time, in various issues of your splendid magazine, I have noticed *hydrogen sulfid generators* of numerous



This Highly Efficient Hydrogen Sulfid Generator Can Be Made Up from Glassware Found About Every Amateur Chemist's Laboratory.

types and styles described, but I have come to the conclusion that none of them work as easily or are constructed so simply as the one I now have in use in my chemical laboratory. I give herewith a drawing of the same, and will try to render a coherent explanation of its manipulation.

I will first make a notation of the apparatus used:

1 Aspirator bottle.*
1 Woulff bottle (three neck).
1 Calcium chloride drying tube.
1 Large bottle.
Glass tubing.
Rubber tubing.

I will now give a list of the apparatus and liquids denoted by the letters in the drawing:

"A"—Hydrochloric acid.
"B"—Iron sulfid.
"C"—Mineral wool or asbestos.
"D"—Water.
E, E', E"—Pinchcocks.
"G"—Hydrochloric acid.

I don't think it will be necessary to go into detail in reference to the construction of the apparatus, as I believe the sketch fully covers that, but give here a few points on the manipulation:

Open the pinchcock E" and allow the HCl to flow into the Woulff bottle; this will compress the air in the Woulff bottle. When the HCl stops flowing from the aspirator bottle, owing to the compression of the air, close the pinchcock E". Now open the pinchcock E and the HCl (G) will rise in the calcium chloride drying tube, thereby covering iron sulfid (B). (If the compression of air is not sufficient in the Woulff bottle to do this, again open pinchcock E" until the HCl rises in the drying tube sufficient to cover iron sulfid (B). Open pinchcock E and the gas generated will pass over into the large bottle containing the water (D). In this bottle the gas will be washed, and will also form a supply of the gas above the level of the water. Open the pinchcock E' and the gas will flow in a steady stream.

When one is thru with the gas all that is necessary is to close pinchcock E' and then close pinchcock E. Gas will continue to generate and will, owing to no outlet being open, force the HCl, covering the iron sulfid, back again into the Woulff bottle.

When the strength of the HCl, "G," becomes exhausted it can be removed from the Woulff bottle and, owing to the filtration caused by the mineral wool "C," is ready for evaporation for the recovery of the ferric chlorid. Another feature is that one has at all times hydrogen sulfid water on hand owing to the washing of the gas in the large bottle thru the water D. The reason for using a three-neck Woulff bottle is this: that when the pressure in the Woulff bottle, caused by the compression of the air, and also the gas liberated when pinchcock E, is closed immediately after use, will sometimes become too great for the strength of the glass, and so as a "safety first" measure, the three neck bottle is used so that the cork in the center, not in use, will act to liberate the surplus pressure.

Contributed by
WILLIAM N. NUSHAWG.

* An Aspirator bottle is not necessary, as the liquid (A) can be syphoned out of any ordinary bottle.

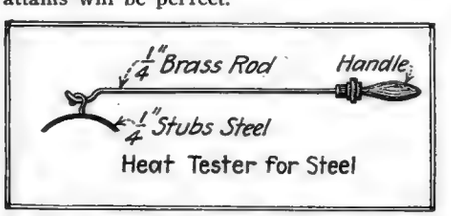
MAGNET TEST FOR HEAT OF STEEL.

One of the best and little-known methods of determining the correct heat at which to quench a piece of steel to obtain the best results, without the use of a pyrometer, is the following:

Take a piece of ¼" Stubb's steel about 2" long, tap a small hole in the center for a small screw eye, then harden and magnetize after bending to the shape shown in illustration. Place in screw eye and hang on the end of a brass rod bent to the shape shown in sketch.

The princple of the method is based on the fact that a piece of steel will not attract a magnet after a certain temperature is reached (about 750° Fahr.).

The little magnet is held over the heated steel every few minutes until the heated steel no longer attracts it, when it is then quenched and the degree of hardness it attains will be perfect.



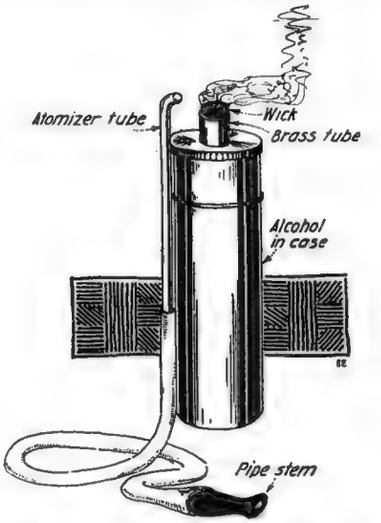
The Principle of This Steel Heating Tester Is That Above a Certain Temperature Steel or Iron Will not Attract a Magnet. Hence: When Is a Magnet not a Magnet? Answer. When It Is Red Hot.

Of course, the steel is to be drawn again to the required color. The above method is known to a very few mechanics.

Contributed by T. W. BENJAMIN.

AN ALCOHOL BLOW-TORCH FROM JUNK.

Want a nice little blow-torch? Below are given the details of an easily made blow-torch that will give as good results for soldering, etc., as the regular torch. It is constructed from a nickel-plated shav-



Who Wants an Alcohol Blow-Torch? Every Electrical Man, and Here's How to Make One from a Shaving Stick Case for Nothing. If You Are a Religious Prohibitionist You Can Burn Gin or Whiskey in Your Torch.

ing-stick case. The top of this case has a hole about three-quarters of an inch cut into it, and a piece of brass tubing inserted and soldered. Thru this runs the cotton lamp wick, dipping into the alcohol, contained in the case. Cotton wicking can be purchased in any hardware store. A piece of an atomizer tube, bent as shown in the illustration, is soldered or otherwise secured to the side of the case, connecting with a rubber tube. At the end of this a mouthpiece from "Pop's" old pipe stem is fastened. This makes a good, neat torch, welcome in any work shop or "lab."

Contributed by GEORGE H. TRUITT.

MAKING CHLOROPHYL.

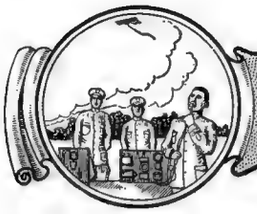
Chlorophyl is the green coloring matter common to growing plants. Take a handful of parsley and triturate in a mortar with enough alcohol (95%) to cover the mass. Decant the green liquid and allow it to evaporate spontaneously. The chlorophyl remains as an intensely green substance. This may be used to color candies and as cake icings.

Dye from Onion Skins: Take the outer skins from half a dozen onions (medium-sized) and boil in water until the color is extracted. This is a very suitable yellow dye.

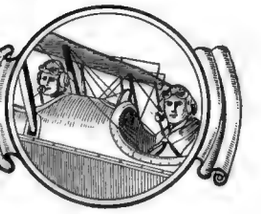
Test for the Purity of Olive Oil: Shake equal volumes of the oil and nitric acid. Pure oil should turn from pale to dark green in a few minutes. If it changes to brown, red, or orange, the addition of a foreign oil is indicated.

Heat for five minutes in a water bath at 100°C. It should become pale yellow to orange yellow. On standing it will, if pure, become a yellow solid.

Contributed by FRITZ ZILLESSEN.



RADIO DEPARTMENT



The "Fog Warning" Radio Telephone

THE accompanying illustrations show the interior mechanism used in the wireless telephone "fog warning" signal installed at the Point Judith Light near Narragansett Pier, R. I. This is one of the most treacherous sections on the Atlantic coast for ships to negotiate. For some time the DeForest "Radiophore" has been in use at this lighthouse station. It comprises an old type cylinder phonograph fitted with a record and repeating mechanism, which operates an Oscillion vacuum bulb, in such a way that the following warning is sent out by wireless telephone waves from an antenna, to ships as follows: "Point Judith Light," which is repeated three times. Then the skipper on the boat, or his wireless operator, hears, "You are getting closer, keep off," at about ⅓ volume of the first warning. Until the vessel approaches the danger limit, it does not hear the necessary final warning, but simply the first "location" warning.

The energy used in operating this warning signal is one-fourth kilowatt. The Oscillion vacuum tube generator of the radio frequency oscillations, is a 3¾-inch bulb. Heretofore the wave length was varied automatically for the different signals by a motor-driven variometer, but owing to the difficulty experienced by the ship radio operators in trying to pick up the constantly changing wave length signal and to hold it, the warning is now sent out on a fixt wave length of 600 meters, whereas with the constantly changing wave length previously used, the final message, "You are getting closer, keep off," was liable to be mist.

The first real test of this apparatus has been taking place at Point Judith Light (near Narragansett Pier), and the apparatus is arranged on a very compact scale so that it can be attended to by the regular lighthouse keeper and assistant. A regulation gasoline engine connected with a 36-volt direct-current generator and storage batteries is used to supply the energy, to which is coupled a motor-generator set which operates the transmitting apparatus.

This apparatus is entirely enclosed in a compact cabinet measuring about 18x18x18 inches. On the front of the cabinet is the Oscillion bulb and necessary switches for regulating it; also connection posts for aërial and ground wires. On the side of the cabinet is a small door which gives access to the mechanism inside.

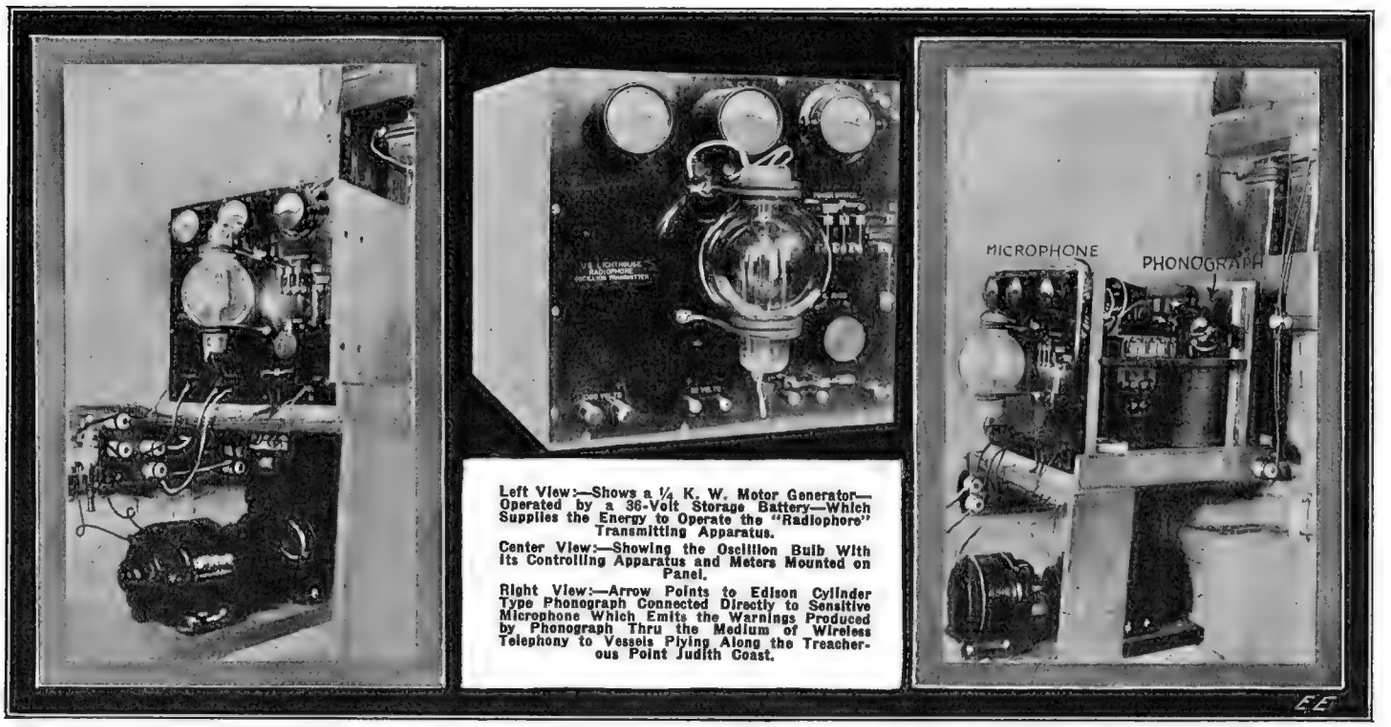
All the working parts are mounted inside the cabinet, including a motor-driven phonograph (see photographs herewith), speaking directly into a microphone. The arrangement of the cylindrical records is such that they repeat automatically, the saffire needle being set back to the beginning each time after it has traveled the length of the record. Each record has an average life of about 60,000 repetitions.

In the circuit diagram may be seen the relative layout of the various horns, microphones, and the Oscillion bulb generator of the radio frequency oscillations used to propagate the vocal message.

Several other modifications of the underlying principles may also be utilized as described in Dr. de Forest's patent. The transmitting apparatus is so arranged that speech can be sent out from the large fog horns, as also musical notes, bell signals, et cetera; on the same prearranged schedule as the radio signals. In this scheme the phonograph with records containing speech, is coupled to a microphonic arrangement and the speech is intensified by means of audion amplifiers and the sound waves sent out thru the fog horns, thereby enabling the captain or other officer to hear the same by ear, *without* the aid of wireless apparatus.

The one big feature of the Point Judith Light equipment is that when a ship is within a range of eight miles of the lighthouse, it will hear the following words flashed by wireless every five seconds: "Point Judith Light;" and after every

(*Continued on page* 462)



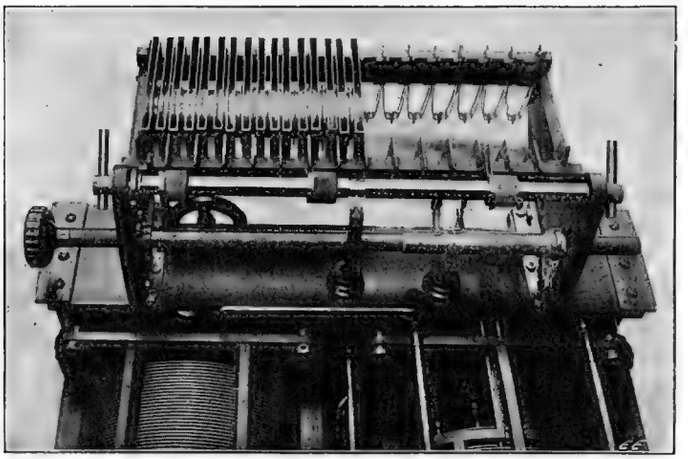
Left View:—Shows a ¼ K. W. Motor Generator—Operated by a 36-Volt Storage Battery—Which Supplies the Energy to Operate the "Radiophore" Transmitting Apparatus.

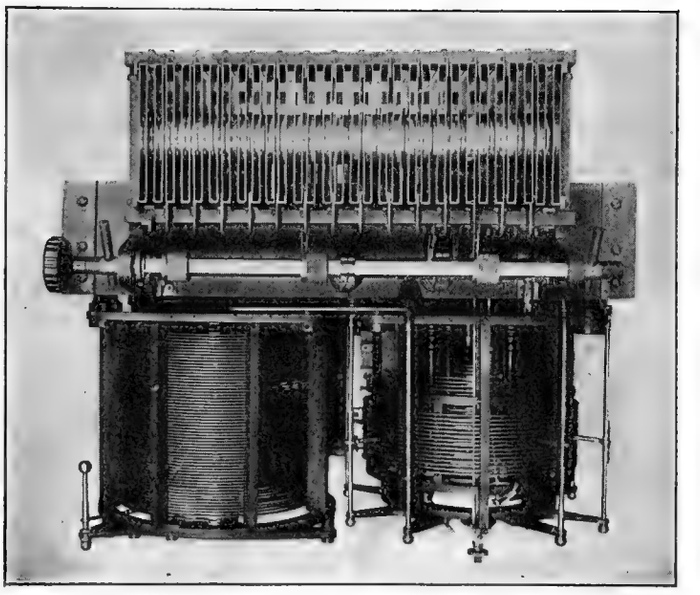
Center View:—Showing the Oscillion Bulb With its Controlling Apparatus and Meters Mounted on Panel.

Right View:—Arrow Points to Edison Cylinder Type Phonograph Connected Directly to Sensitive Microphone Which Emits the Warnings Produced by Phonograph Thru the Medium of Wireless Telephony to Vessels Plying Along the Treacherous Point Judith Coast.

In September "Radio Amateur News"

Grand Opera by Wireless. By H. Gernsback.
Guarding the Ether During the War. By P. H. Boucheron.
Construction of an Audion "B" Storage Battery. By Herbert Webb.
Static Eliminator of Considerable Merit. By Edgar Terrain Johnstone.
Wireless Telegraphy with the Canadians at the Front. By J. W. Caucor.
The Double Deck Receiver.
A. B. C. of Wireless Reception. By H. K. Dunn.
The Latest Design Antenna Switch. By E. T. Jones
The Lure of Radio. By Eugene Dynner.
A Pocket Size Receiver. By J. E. Aiken.
Value of the Radio Compass. By L. A. Pollock.
Junior Radio Course—Lesson 1. By E. T. Jones.





Two Views of the Navy Type Quenched Gap Used on New 1 K. W. Panel Radio Transmitter. The view at the Left Shows the Quenched Gap With Several of the Units Removed While the View at the Right Shows a Top View of the Panel and Quenched Gap, With All of the Gap Units in Place. The Long Rod Placed at the Side of the Gap and Provided With a Large Insulated Knob at One End, Controls a Power-changing Switch, Which Switches In or Out of Circuit More or Less of the Gaps, as Required for Various Transmitting Powers.

New 1 K.W. Quenched Gap Transmitter

By Lester F. Ryan

THE 1 K. W. panel radio set as is described in the following article, is identically the same in principle and operation to the one described in the July issue of the ELECTRICAL EXPERIMENTER, except for the spark gap. The panel consists of two bakelite-dilecto pieces, the upper panel having the hot wire ammeter, wave changing device and the spark gap mounted upon it. The lower has the volt and ammeter control switches and automatic starter mounted upon it. The voltmeter is of the double scale type. The motor-generator is of the Crocker-Wheeler type, and is driven counter clockwise from the motor end by direct current at 120 volts. It is rated at 2 1/10 horsepower and 1.25 K. V. A. or 1000 watts, at 80 per cent power factor. It is a 500 cycle machine and has 15 field poles. The motor field is controlled by a Ward Leonard 18 point rheostat. This varies the frequency between wide limits. The automatic starter consists of five parts, two solenoids, and two contact discs and plunger, also a common resistance box.

The transformer used with this set is of the closed core dry-type and is rated at 1000 watts, 500 cycles and 150 volts at the primary winding terminals. The ratio of transformation is 38 to 1. It is insulated to stand electric stresses of 30,000 volts and will stand a 50 per cent overload.

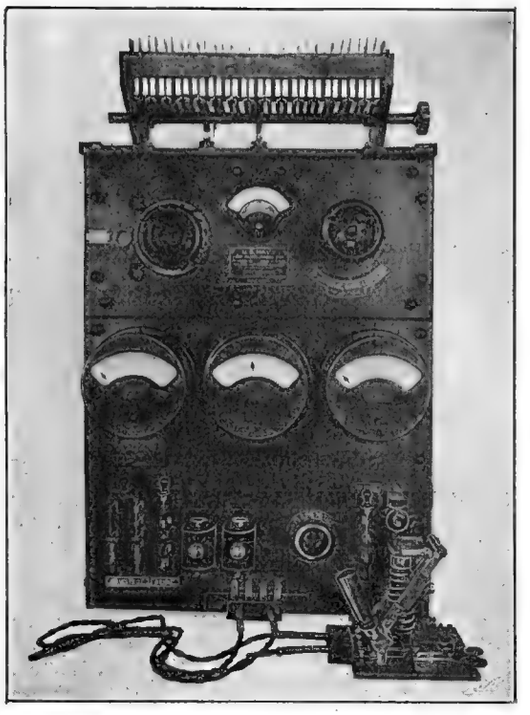
The condensers used are of the Dubilier type of .004 microfarad capacity each, connected in parallel. They are made of selected mica and tested for 100 per cent overload which is more than is ever used.

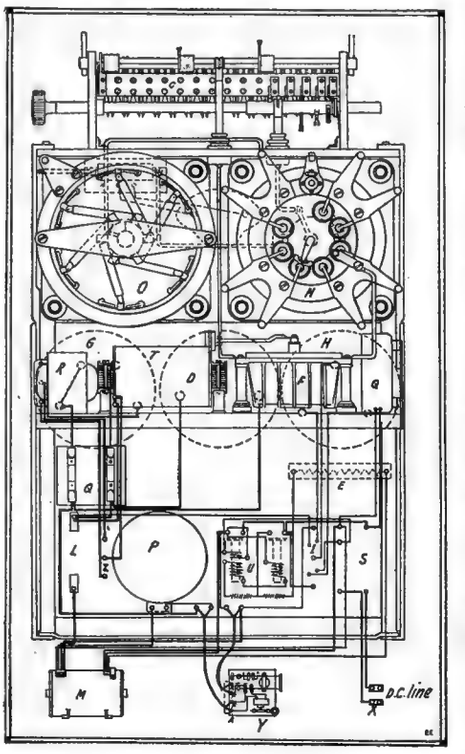
The spark gap which is used with this set is mounted on the top of the panel as shown in figure. The gap consists of a *gap holder* and *power changer*. The gap is horizontal and has a row of fifteen pockets; each pocket accommodates a gap unit as shown in photos. When a gap unit is inserted in a pocket it separates two leaf springs. The pressure of these springs against the gap insures perfect contact. The springs come together as a gap is removed and in so doing bridge the break in the gap holder circuit.

A switching mechanism is also associated with this holder. It consists of two shafts, one above the other and parallel to the row of gap pockets. Each shaft is provided with switch jaws which engage knife blades fitted to the gap holding pockets as shown in figure. The top switch shaft is used for the changing of power. Each movement of its handle inserts or removes gap units in groups. The switch jaws slide over this shaft so that the operator may vary the number of the gaps in a group at will. The three positions of this switch are *Low, Intermediate and High.*

The second and lower switch shaft allows five gaps to be inserted one at a time. The switch engages knife blades projecting from the rear of the first five gap pockets as will be seen. This

(*Continued on page* 471)





Front and Rear Views of 1 Kilowatt Quenched Gap, Panel Radio Transmitter. This Set Has Been Extensively Adapted by the United States Navy and Has Given Excellent Satisfaction. The Quenched Gap Units Are Easily Replaced at a Moment's Notice and Can Be Quickly Repaired When Necessary. The Gap Plates Are Separated by Thin Fish Paper Gaskets. The Set is Noiseless in Operation.

Valves

By PROF. A. U. DION, G.R.I.D., D.C., A.C., H.F.C., T.S.F., etc., and MR. LETIT LEAK, E.M.F., O.T., etc. (Local Plumber)

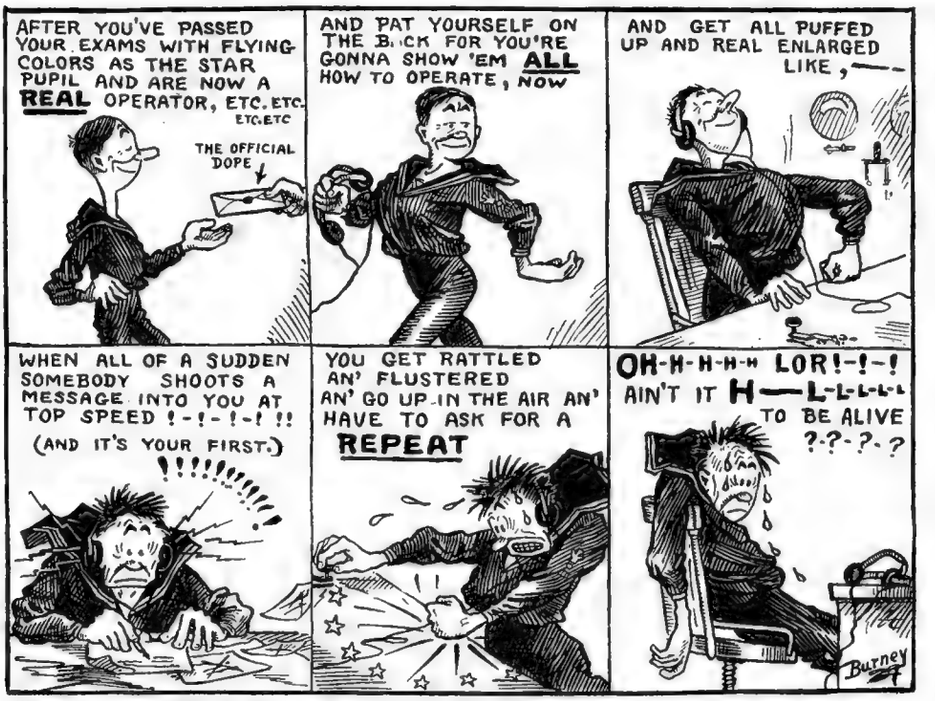
Introduction

In this little article I have tried to set down a few facts and fancies regarding the valve as used in the practice of wireless telegraphy.

They are the direct result of information collected whilst acting in the capacity of W/T operator in one of Britain's aërial dreadnoughts, although much of the advanced technical matter is the result of Mr. Letit Leak's untiring research, and to this gentleman I publicly extend my heartfelt thanks for his invaluable assistance in compiling this treatise.

Author's Note

Thru long association I had come to look upon the W/T valve as the only valve in the wide, wide world, so vividly were its advantages and merits imprest upon me at Cramwell College. I am assured by Mr. Letit Leak, however, that this is quite a fallacy. He tells me that there are H.P. and L.P. steam valves, gas valves, ball valves, and bi-valves, not to mention innumerable others, besides the common or garden dot-and-dash variety.


AFTER YOU'VE PASSED YOUR EXAMS WITH FLYING COLORS AS THE STAR PUPIL AND ARE NOW A REAL OPERATOR, ETC. ETC. ETC. ETC.
THE OFFICIAL DOPE
AND PAT YOURSELF ON THE BACK FOR YOU'RE GONNA SHOW 'EM ALL HOW TO OPERATE, NOW
AND GET ALL PUFFED UP AND REAL ENLARGED LIKE,
WHEN ALL OF A SUDDEN SOMEBODY SHOOTS A MESSAGE INTO YOU AT TOP SPEED !-!-!-! !! (AND IT'S YOUR FIRST.)
!!!!!!!!!!
YOU GET RATTLED AN' FLUSTERED AN' GO UP IN THE AIR AN' HAVE TO ASK FOR A REPEAT
OH-H-H-H-H LOR!-!-! AIN'T IT H—L-L-L-L-L TO BE ALIVE ?-?-?-?
Burney

"Learning the Code" Is Right—First You "Think" You Learn It—Then You Really Learn It All Over Again, As Mr. H. B. Burney Here Illustrates In His Own High Frequency Style.

Valves W/T may be placed in four categories:

(1) The Round Valve (deriving its name from the inventor, not from its shape).

(2) The Hard Valve (has slightly longer life than the soft valve when exposed to the tender mercies of the new operator thirsting for knowledge).

(3) The Soft Valve (so called because it is satisfied with fewer volts than the foregoing instance, and therefore does not require so many ration books).

(4) The "Q" Valve (better known as the "Hush, Hush" valve). By simple proportion it will readily be seen that 31,967 such valves would receive signals from the planet Jupiter.

All four types are much of a muchness in general principle, differing only in detail.

Taking them collectively, a valve consists of a chunk of vacuum surrounded by a layer of glass. A most essential part is the small tip generally found on top of the vacuum. Its precise use has yet to be determined, but Mr. Letit Leak assures me it is a most important *point*. I do not intend to trouble my readers with smaller details, but, in passing, it is imperative to direct attention to a fundamental necessity, which valve manufacturers dare not overlook—viz., the necessity for placing some small parts within the vacuum. These are:

(1) *The Filament.*—A very fragile piece of tungsten made up of 10^{88} negative electrons. Its function is to illuminate the vacuum in order that the student may see how the other parts work.

(2) *The Grid.*—Consists of a number of holes joined together by small pieces of metal. Acts as a shade over filament to protect student's eyes.

(3) *The Sheath.*—A sheet of metal enclosing both the filament and the grid. Prevents small pieces of vacuum, dust or dirt from falling on the filament and affecting its lighting capabilities.

At the bottom of the valve are a number of tags, generally four, although a few more or less should not worry the student. I was under the impression that these were to form a convenient method of holding the valve without making the glass dirty, but Mr. Letit Leak emphatically insists that these tags exist for the sole purpose of ensuring connection with the internal economy of the valve.

To Test Valves.—Carefully examine, and any cracks in glass bulb should be caulked with shellac to prevent the vacuum getting out.

To Test Filament.—Grasping the valve by the tags previously referred to, bang the valve several times in rapid succession against the edge of a bench (unless an anvil is handier), when it should give forth a clear, bell-like note. Should the filament fail to glow after this test, don't waste more time with it, but get another from the stores.

To Test H.T. Circuit.—Connect up to several thousand volts and forget the exact amount. A faint bluish glow will indicate that the H.T. has successfully run the gauntlet of the vacuum and is looping the loop between the filament and sheath, a process known technically as *oscillation.* Should no blue glow be detected and the valve and student still survive, throw the valve away—it is a dud.

To Test Vacuum.—Knock off small tip mentioned previously, and if vacuum is good a faint hissing noise is heard. When the hissing ceases, it denotes that Nature, which abhors a vacuum, has discovered the escape. It is not advisable to apply this test except as a last resource, owing to the extreme difficulty of re-packing the vacuum thru the small hole thus made in the glass.

From the foregoing remarks the student must draw his own conclusions as to the advantages of valves. Our W/T officer says that their tendency to disappear completely and mysteriously is not so marked as that of the carborundum crystal. He attributes this to the post-war amateur not being possest of sufficient filthy lucre to purchase enough high tension to operate the valve, while the current price of volts is so excessive.

Finally. — Mr. Letit Leak informs me that, owing to the super-sensitive qualities of the valve as a detector, it is probable that Scotland Yard will shortly assume the entire control of the valve industry, and every detective will be fitted with seven valves. Police constables, on the other hand, will only be provided with amplifiers.—*Wireless World.*

DE FOREST DEFENDS HIS 3-ELEMENT AUDION

In the interest of fair play and scientific fact Dr. Lee de Forest, acknowledged among scientists as the inventor of the 3-electrode audion or vacuum tube which has made possible the present development of the radio telephone, has made public an open letter to the Editor of the *London Morning Post,* England, protesting against the reported unfair statement of Dr. J. A. Fleming, British scientist, in connection with his series of Cantor lectures in the theatre of the Royal Society of Arts.

The letter written by Dr. de Forest is based upon an article publisht in the *London Morning Post* of February 25th entitled "The Future Telephone—Imperial Conferences by Wireless" in which the perfection of the three-electrode audion is credited to Marconi. The article reads as follows:

"Dr. J. A. Fleming yesterday concluded his series of Cantor lectures in the theatre of the Royal Society of Arts with an account of the thermonic and crystal detectors, which, as he said, have taken an important part in the war. He described how the radiant point from which wireless messages are sent, could be determined by angles taken from two receiving stations, so that the exact position of ships and Zeppelins could be ascertained, and that means whereby electric oscillations could be detected thru the telephone in an airplane above the sound of the engines. Thermionic detection has been enormously developed, and the audience was interested to hear how these instruments, which are the basis of wireless telephony, arose from the discovery by the lecturer himself of a method of utilizing the curious fact that an ordinary filament lamp when incandescent

(*Continued on page* 460)

Vacuum Valve Construction

By R. H. Shaw

By reading this article carefully any Amateur should be able to construct a vacuum detector which will give excellent results. The completed valves are shown in Figs. 1 and 2 as well as connections for them. Several other connections may be used, but those shown have been found best.

In the construction of the valves an incandescent filament is used to produce the electron flow. For this purpose a miniature incandescent lamp with a carbon filament using about three volts should be used.

Having obtained such a bulb place a very thin strip of copper around it, as shown in Fig. 3. Fasten this plate by means of the nut and bolt (B). The plate connection is also made to this bolt.

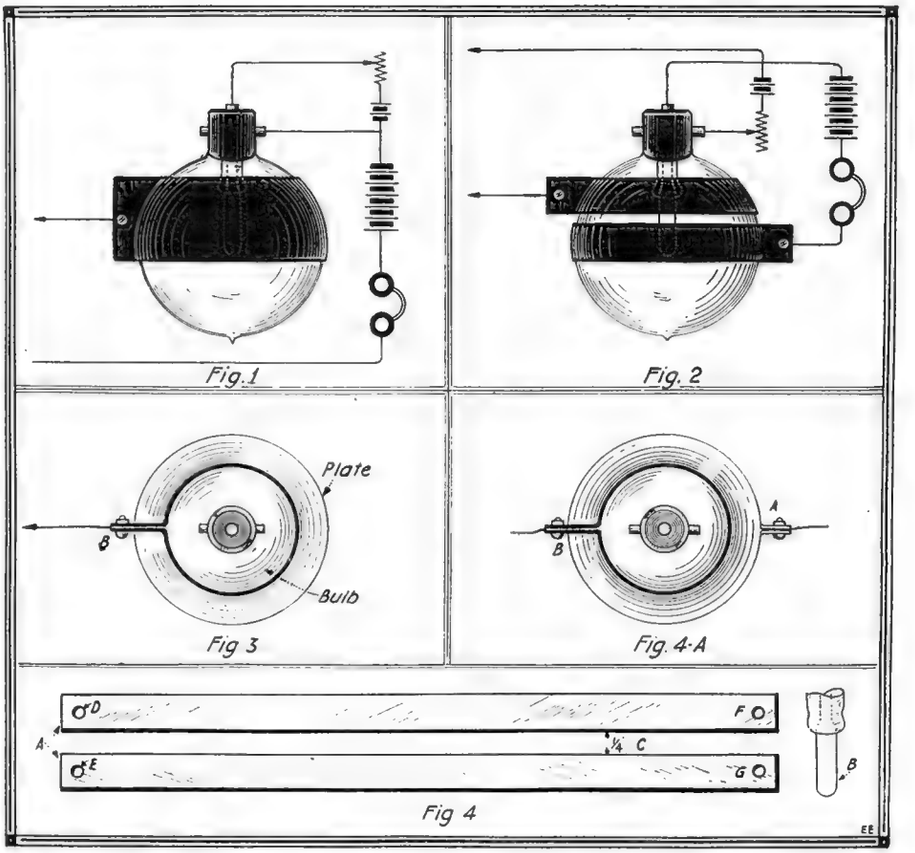
The valve is now ready for use and is connected up as shown in Fig. 1. Adjust the filament to a very high brilliancy, being careful not to burn it out. Do not touch the filament adjustment having once adjusted it, but use the "B" battery potential until the incoming signal is heard loudest in the 'phones.

In Fig. 2 is shown a second type of detector. This differs from the one just described in that its plate is divided. A lamp of the same kind used in the above detector is used for this one.

The construction of the plate for this valve is shown in Fig. 4. A thin strip of copper long enough to go completely around the bulb as shown is first cut (A). This plate should be a little wider than the filament (B). Having cut the strip to the right dimensions a piece one-quarter of an inch wide is cut out (C), Fig. 4. The holes D, E, F, G are next drilled. The two plates are then fastened around the lamp and secured to the bolts (A and B), Fig. 4-A. The plate connections are also made to these bolts.

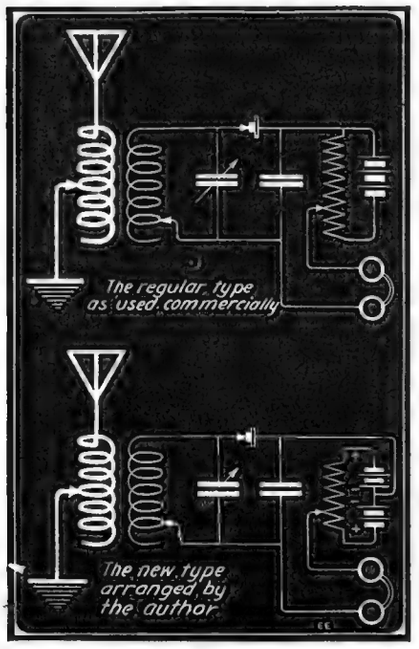
The valve is now completed and is connected as shown in Fig. 2. This valve is adjusted the same as the other one. An "A" battery of six volts and a "B" battery of fifty volts should be used with these valves.

The theory of operation of these valves is: As the glass becomes heated it allows the electrons being discharged from the filament to flow thru it and make connection with the plate on the outside of the lamp. The circuit from the filament to the plate is thus completed. It is therefore advisable to use a lamp containing a carbon filament as it produces more heat than a tungsten filament. The valves described herein are fully protected with patents and must not be manufactured for sale.



Home-Made Audion Designs for Two and Three Electrode Units. Made from Ordinary Single Filament Auto Head Lamps, Purchasable in Any Auto Supply Shop.

The Potentiometer—How to Use It



Above—the Old Way, and Below—the Improved Hook-Up for Obtaining + or — Current from a Potentiometer Circuit Without Switches

There has been very little said in print in regard to the use of this very important and effective instrument as a regulator of battery current which aids some types of crystals decidedly in their functioning.

In the majority of cases upon visiting the ordinary and even the advanced class of Amateur or Experimental stations, I have found that probably one in a hundred made use of this very necessary piece of apparatus. Once used, no one will do without it, owing to the following facts:

1. There is absolutely no carborundum which is not greatly increased in sensitiveness by its aid.

2. I have found upon investigation that there is not a piece of silicon which does not function better, to a greater or lesser degree, according to the kind used, by the aid of minute battery current and a potentiometer for regulation.

Even tho some experimenters do make use of a potentiometer they do not in all cases thoroly understand its operation and correct use in order to derive best results.

As a general rule potentiometers with a critical point of adjustment should be employed. Such a potentiometer would be one wound with fine wire and an over-all high resistance. This affords greater life to the battery shunted across it and allows one to hold point of adjustment at a greater length of time due to the fact that with large wire the battery dies out more rapidly and then it is necessary to readjust the potentiometer to allow the same amount of battery current to flow thru the detector.

A sliding contact potentiometer, if well constructed, should be used instead of the switch contact point arrangement, owing to the fact that it is impossible to arrive at an exact or critical point of adjustment with the latter.

Another point of great interest in connection with this apparatus is that the right polarity must be maintained, and in order to do this with the commercial form of potentiometer, it is necessary to first connect the detector or battery and "adjust"; if no increase in signal strength is found, it is then necessary to transpose either the battery or detector leads. To overcome such annoying procedures as just mentioned the author has arranged the following circuit for the potentiometer, which makes it unnecessary to change the leads of the battery or detector.

The instrument is termed a "duplex polarity potentiometer," and works in the following way: As will be seen from the diagram, the potentiometer is shunted by two batteries opposing each other; therefore no current will flow when the potentiometer slider is in the exact center of the instrument or windings of the same. If it is moved above center one set of polarities is had, and if moved below another set is obtained.

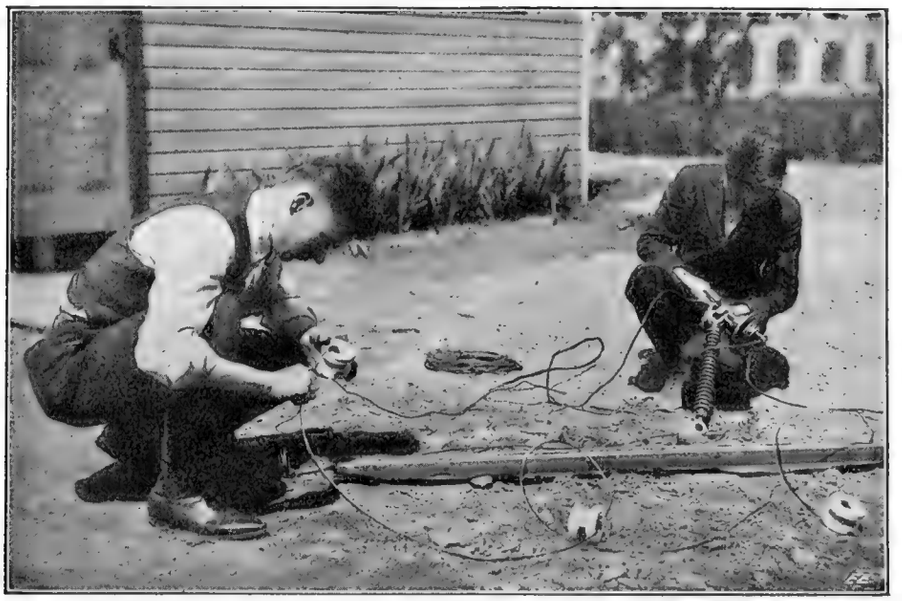
Contributed by E. T. JONES.

The How and Why of Radio Apparatus

By H. WINFIELD SECOR

NO. 12, RADIO ANTENNA CONSTRUCTION

From time to time we will describe one particular instrument used in either the radio transmitting or receiving set, explaining just how it works and why. We have received so many requests from new readers for such explanations that we have decided to publish this matter in serial form. In the course of several issues all of the principal transmitting and receiving apparatus will have been covered. The subject for the twelfth paper is "Radio Antenna Construction."



Here We See Two Earnest Radio Amateurs Preparing the Antenna. The Insulators Must Be Tied or Wired on Very Firmly to Withstand Wind Storms. The Spreaders and Metal Fittings Should Be Thoroly Painted.

TYPES OF AËRIALS.

THERE are various types of antennae adapted to the amateur and experimental requirements. Among the usual types of antennae with which Radio Amateurs are familiar are the "T" and inverted "L". The so-called umbrella aërial is quite familiar to some workers in experimental radio, but is seldom used except in more or less elaborate stations where experiments are carried on for *directive* effects. A typical form of inverted "L" aërial and the proper connections for the wires composing it, is shown at Fig. 1 in the accompanying diagram. Fig. 2 shows an approved form of "T" aërial. The "T" form of aërial has a smaller amount of inductance than the inverted "L" type, its mean length being the length of the lead-in and rattails, plus one-half the length of the flat top. Hence, under certain conditions, as for instance, where two tall trees or other elevations may happen to be available, the whole may have to be exceptionally long for the requirements in question, then the inductance may be reduced by using a "T" connection, thus giving a lower operating range of wave lengths for the whole antenna. The inverted "L" type aërial is fairly *directive* in its activity, and Fig. 3 shows the maximum directive effects both for transmitting and receiving. As Fig. 3 shows, where there are two inverted "L" antennae in use at two stations working with each other, such as in trans-Atlantic radio telegraphy, then the two inverted "L" aërials should point away from each other. In other words, maximum transmission or reception takes place *in a direction opposite to the free end* of this antenna, as the arrows indicate. Also, the longest distance station you wish to receive from should be in a direction opposite to that in which the free end of the aërial points, or in a direction pointing away from the knee.

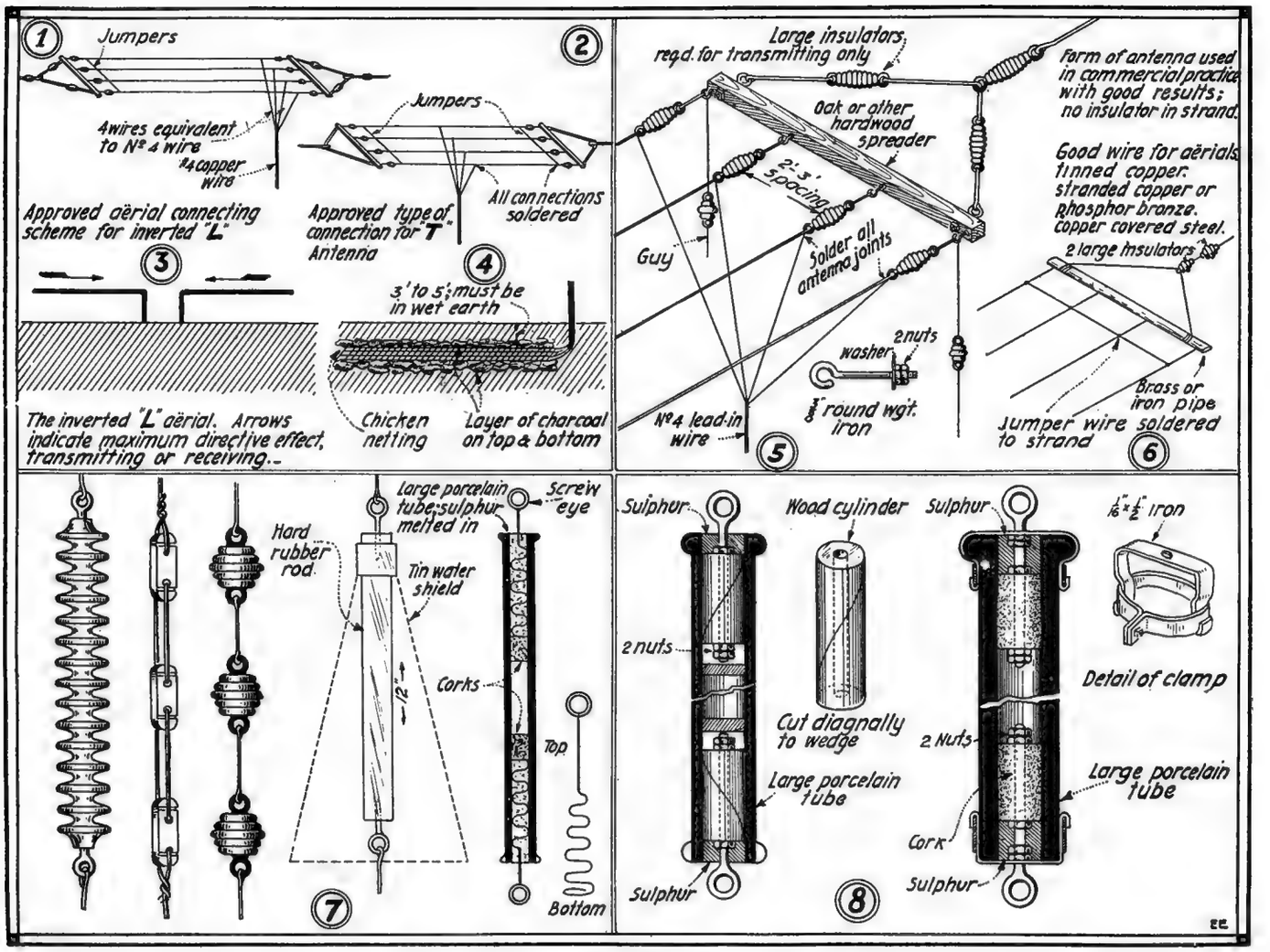
There are two new forms of antennae, which will warrant considerable experimentation on the part of the Radio Amateur Fraternity, as they possess many very desirable features. They materially reduce the construction labor and expense, not to mention the danger in windstorms from the destruction of masts, etc., and furthermore these new aërials can be used during thunder-storms, which has never been the case with the best of overhead antennae. The aërials of which we speak are the *surface* and *underground* antennae.

Not very much has been said in print concerning the *surface* antennae, which is formed of several insulated wires laid on the ground and then connected to the apparatus, which apparatus may or may not be connected to the usual ground. But very excellent work has been accomplisht indeed with these aërials by Dr. Taylor, of the University of North Dakota. Messages have been received over distances of several thousand miles with aërials of this type.

The other form of ground aërial, namely the *underground and underwater antennae,* devised by Dr. James Harris Rogers, of Hyattsville, Md., possesses many very meritorious and heretofore unobtainable features, such, for instance, as permitting the reception of radio messages right thru heavy thunder-storms, when the static in regular elevated antennae was so severe that sparks would jump clear across the aërial switch, eight to ten inches long.

In the present article we will deal more with the construction of the *elevated antennae,* as it will undoubtedly be used for a considerable time by Radio Amateurs and Experimenters, owing principally to the fact that it is rather difficult for amateurs to construct a sufficiently well-insulated Rogers underground or Taylor surface antennae, which will hold the charge of several thousand volts from a transmitting set, without breaking down the insulation to earth and thus destroying its efficiency. We would refer the reader to the original article on the Rogers underground antennae by the writer in the March, 1919, issue, and for those who reside in cities or other congested districts and cannot run a long wire in a trench and bury it without being arrested by an ever present "blue-coat," the student so situated will find much consolation in a later article prepared by the writer in collaboration with Dr. Rogers, entitled "The Rogers Underground Aërial for Amateurs," which appeared in the June, 1919, issue, and wherein various forms of spiral antennae which can be used in the operating room or else buried in wells, brooks or down in the cellar, were described. Two other articles in this direction should be carefully studied by the student, the first being "Loop Antennae and Direction Finders for Amateur Use," which appeared in the August number of the *Radio Amateur News,* and the second article, "Concentrated or Loop Aërials," by Prof. Lloyd M. Knoll, A.M., appearing in the August, 1919, issue

Up Goes the Antenna—the Radio Amateur's Heart Now Beats With Joy, for Soon He Will Be Listening to the Etheric Messages from Stations Hundreds and Even Thousands of Miles Away.



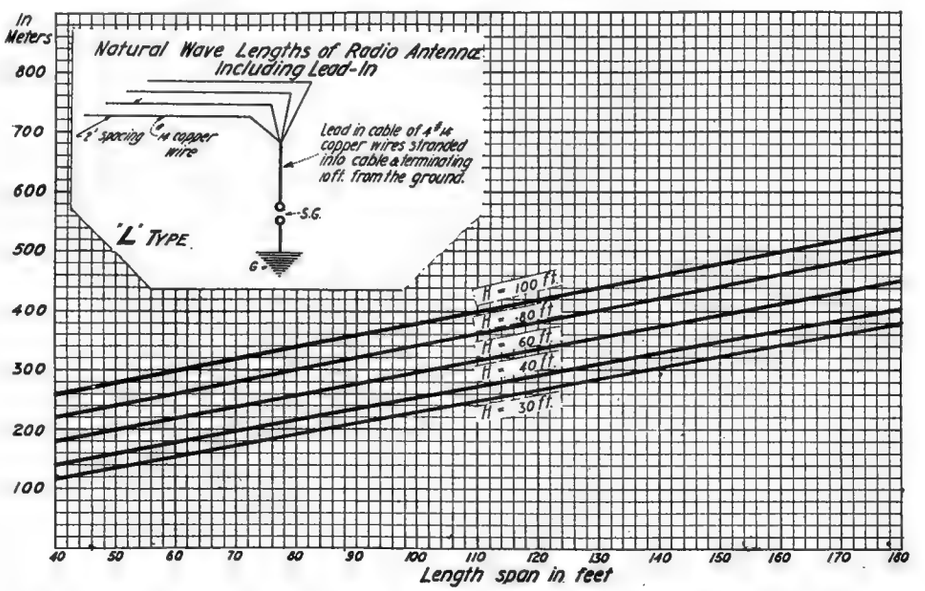
Many Practical Hints on Radio Antenna Design and Construction Are Here Illustrated and Described in the Text. Data Are Given for Calculating the Wave Length of a Given Size of Aerial, as Well as Direct Reading Graphs. See Cut Below.

of the ELECTRICAL EXPERIMENTER Magazine.

WAVE LENGTH OF ANTENNAE.

Undoubtedly the first question that the Radio Experimenter will ask in relation to the antenna which he intends to buid is: "What will the wave length of my antenna be?" In the first place, and altho it might seem almost paradoxical to make such a statement, it may be said that radio experimental stations use antennae of all sizes. You may find that the owner of one station is interested, as a great many are, in receiving or trying to receive signals from the high-power European stations, such as Nauen, Germany; Lyons, France; Rome, Italy; or Carnarvon, Wales, England. Therefore, when such is the case, you will probably be surprised to see an aërial, either underground, surface or elevated, ranging away from the station for a distance of possibly 1,000 to 4,000 feet! These high power stations are using wave lengths almost beyond the dreams of our most eminent radio experts of pre-war days. Wave lengths used by these stations in various parts of the world, including the United States, run up to 10,000, 12,000, 15,000 and 20,000 meters quite frequently.

Before going further, we should consider most probably the size of antenna required in a Radio Amateur station, where a *transmitting set is to be used.* If the new rules for Radio Amateur stations, when they are opened shortly by the Department of Commerce or by the Navy Department, follow those of pre-war days, then the majority of the transmitting stations, in view of the fact that they will be able to transmit over the state border line, will have to be *licensed.* Whether they are licensed or not, however, the transmitting wave length must not exceed 200 meters under the old rule. Unless an inefficient, energy-wasting *series condenser* is to be used in the ground lead in the aërial oscillatory circuit, then, in order to radiate a wave length not exceeding 200 meters in length, the antennae to be employed can hardly exceed 80 feet in length for the flat-top, with an altitude of 50 to 60 feet, (*Cont. on page* 462)



Direct Reading Wave Length Graphic Chart for Various Lengths of Four-Wire Antennae. What Is the Natural Wave Length of an Inverted "L" Aerial 100 Ft. High, 120 Ft. Long? At 120 on Lower Scale, Look up Line Till It Meets Diagonal Marked H = 100 Ft. Follow Horizontal Line to Left, Giving 420 Meters as Wave Length in This Case.

Eccentric Antennae

By EUGENE DYNNER

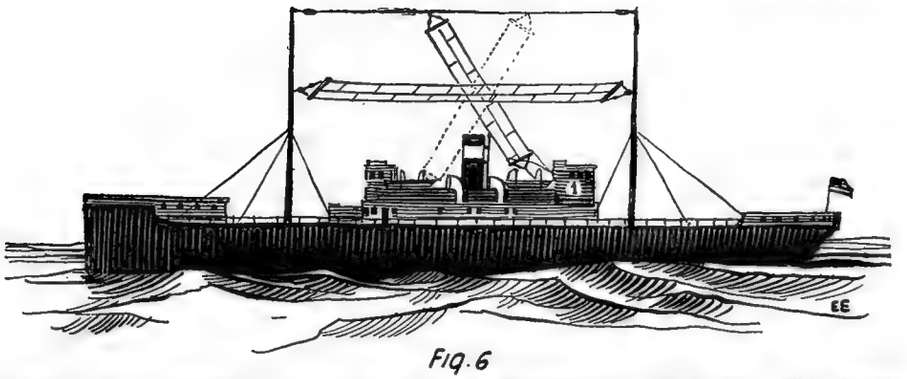


Fig. 6

Novel Form of Eccentric Antenna Tried Out on Ship-Board by the Writer. This Aerial, as May Be Seen, Is of the Cross-Connected Type. With This Form of Antenna, There Was Approximately 50 Per Cent Increase in Strength of Signals Over a 1,500 Mile Range.

SOME time ago experiments were made to develop an antenna which should give the maximum efficiency in reception of radiotelegraphic signals without necessitating the use of expensive apparatus. The first distinctive aërial developed was the one depicted in Fig. 1. This antenna consists of three wires which are connected together at intervals in length twice the width of the spaces between the wires, and measured in such fashion that one of the rectangles formed ends at the center of the adjacent one.

The receiving transformer used was of a special design, consisting of one stationary and three movable coils (Fig. 5). Coil 1 is a primary into which secondary No. 3 may be moved. Coils 2 and 3 also form a primary and secondary which may be brought closer to primary No. 1 or drawn further away. No taps are taken off, there being a double variometer action. A plain galena detector gave excellent results. The entire apparatus was connected as per Fig. 4. Condensers 5 and 6 are of .001 mfd., and condenser No. 7 may be a smaller one.

Using antenna No. 1 with this hook-up, there was an increase in efficiency of about 40 per cent. With coil 2 eliminated and 4 slid inside of 3, a decrease in wavelength resulted and the efficiency was increased about 5 per cent. when an audion was substituted for galena. Efficiency is calculated from results obtained by the use of an ordinary well-built loose-coupler with possibilities for variations by single turns. To test efficiency a device described several years ago in the ELECTRICAL EXPERIMENTER was employed.

With the loose-coupler in circuit and antenna No. 1, it was found that somewhat sharper tuning was accomplisht and signals were louder than those received with the ordinary type antenna.

Antenna No. 2 was found to cause a waste of energy, until the distance between wires 1 and 2, 2 and 3, etc., were separated at least 15 feet. This cage-like contrivance was 150 feet long. Even when this proportion was establisht the increase of efficiency over antenna No. 1 was less than 5 per cent., working under the same conditions.

This Flat-Type Cross-Connected Aerial Showed an Increase of 40 Per Cent in Efficiency When Used With the Receiving Coupler Described

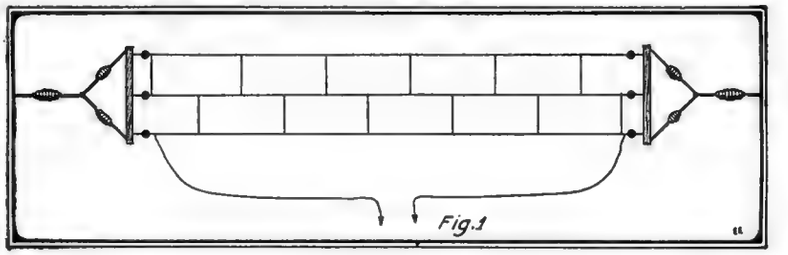


Fig. 1

A composite antenna and "ground" was built, No. 3, which gave excellent results. This arrangement, however, was found most efficient where the capacity of the two bodies was different. Putting the ground above the antenna gave a slight decrease in loudness of signals with broader tuning.

With the antenna depicted in Fig. 6, there was approximately 50 per cent. increase in strength of signals over 1,500 miles away—in direction opposite upper end of vertical antenna—was obtained. Addition of another section of antenna built in direction opposite to first one, gave the same strength in both directions.

In all cases the leads as indicated on diagrams were found most satisfactory. Substitution of single wires for three wire antennae gave practically the same results where the sections were over 300 feet in length, and reception was from stations using wavelengths of over 2,000 meters. For shorter waves the three-wire arrangement was found best.

The United States Navy is using extensively a type of aërial that has been developed in England, and which is used on all her battleships and destroyers. It is termed the "Barrel" type on account of its shape, which is cylindrical. On American battleships, it is anywhere from 75 to 150 feet long. On the smaller type of boat, the aërial must necessarily be much smaller. It consists of six wires arranged in barrel formation and supported every eight feet by three pieces of light bamboo, crost in the shape of a six pointed star. These pieces of bamboo may be of any length, thereby giving the aërial any diameter desired. The diameter is usually determined by the length. On our battleships the diameter of the barrel is anywhere from one to two feet. It may, however, be decreased to six inches for a very small antenna.

For the wire composing the aërial, the United States uses its standard phosphor bronze wire. This wire has been found to be the most efficient in every way. It does not corrode, neither does it rust nor deteriorate in other ways, as the usual kinds of wire do. One big trouble heretofore has been corrosion of the wire in the aërial, due to the action on it of the gases from the smoke stack directly below.

The English government, with whom this type of antenna originated, uses an entirely different kind of wire. They use ordinary copper wire of about No. 12 or 14 B. and S. gage. The bare copper wire is treated with a coat of black enamel, which is made from a specially prepared formula. The enamel coat does not detract from

(*Continued on page* 470)

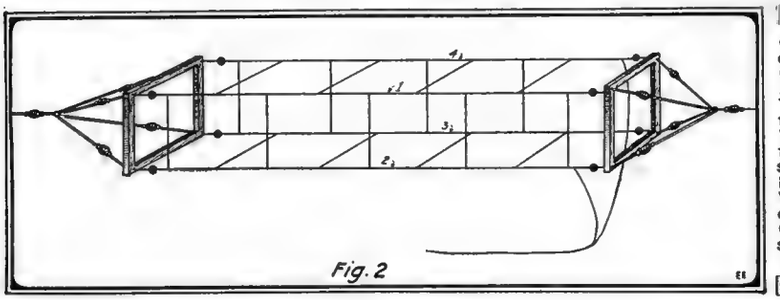


Fig. 2

One Form of Cross-Connected Antenna Tried Out by the Writer With Gratifying Results. The Individual Wires Are of Course Carefully Insulated as Shown.

Novel Composite Antenna and "Ground"—This Design Gave Excellent Results, Says the Author. Placing the "Ground" Above the Antenna Gave Slightly Lower Efficiency.

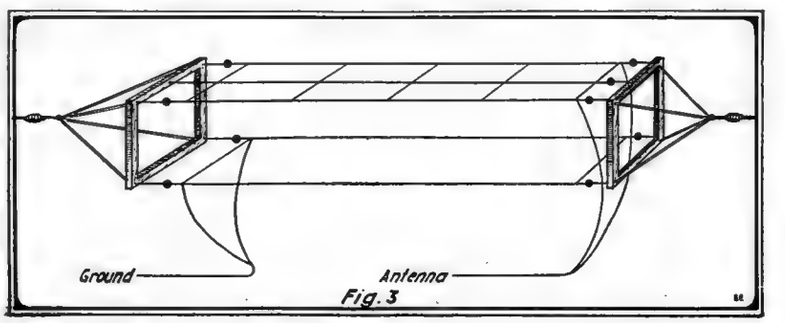


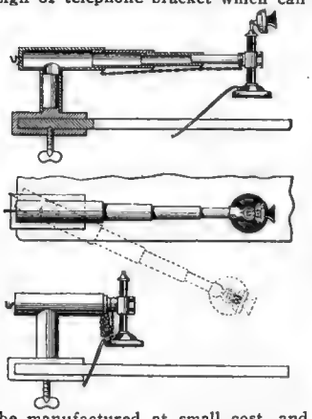
Fig. 3

LATEST PATENTS

Telephone Bracket.

(No. 1,288,611, issued to Edward T. Jones.)

This represents a very simple design of telephone bracket which can

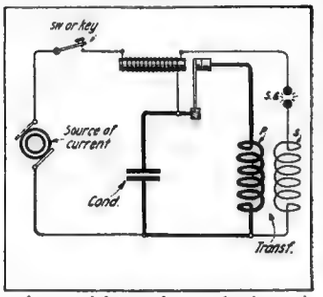


be manufactured at small cost, and still operate with the same efficiency as some of the more expensive and elaborate telephone devices of this character now on the market. The device comprises a series of telescoping metal tubes, which slide into one another when the bracket is to be collapsed, in the manner apparent. A chain is fastened to the successive telescoping sections so that they cannot be put out of alignment or beyond their limit.

Electric Igniter.

(No. 1,307,854, issued to William and Philip Dubilier.)

An electromagnet interrupter is used in conjunction with a condenser

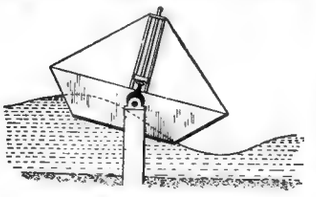


and a special transformer having primary and secondary windings, the primary of which is connected with the interrupter and condenser in such a way that this circuit becomes a tuned oscillator whenever the vibrator is in action. This circuit, in conjunction with a magnetic interrupter, is used to throw a spark across the gap shown, the line current maintaining an arc across the gap.

Wave Motor.

(No. 1,307,095, issued to William Gregersen.)

A surf or wave motor in which the float or body shown is made in the form of a boat pivotally supported, so as to rock with the rise and fall of the wave, and thereby operate a mechanism arranged to rotate a shaft in a continuous circulatory fashion. It is understood that two or more of these wave motor members may be used of course at one location, so as to give a much steadier rotative

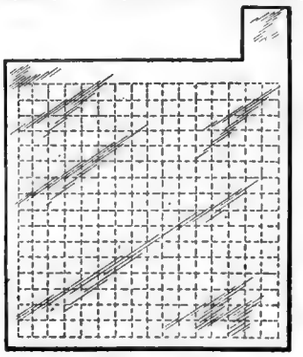


power to the main power shaft, and also to increase the amount of power developed in any instance. The rising and falling float is provided with suitable arms, connected with a set of pawl wheels and ratchets.

Storage Battery.

(No. 1,306,214, issued to Richard J. Crowley.)

A clever scheme providing for a new departure in the manufacture of storage battery plates or grids, having an active agent consisting of lead oxid and aluminum sulfate, and a method of producing a battery plate or grid paste of this compound. One object is to provide a battery element which will permit charging and discharging at a rapid rate without injury to the plates; providing a higher voltage at a heavy discharge and having a greater capacity in ampere-hours than other

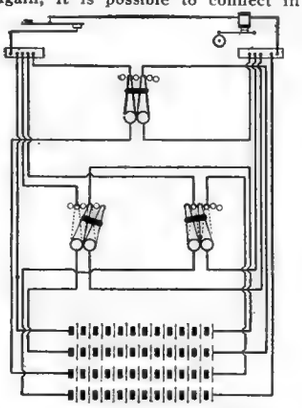


lead cells. Positive elements so made are said not to disintegrate as rapidly as peroxid of lead positives. The electrolyte used may be composed of sulfuric acid and water, but better still it is formed with an acid sulfate of aluminum. This is adaptable for transportation as a solid and only requires the addition of distilled water to form an electrolyte.

Battery Switch.

(No. 1,306,147, issued to Simon B. Hess.)

One of the principal objects of this invention is to provide a battery switching system by means of which large ampere-hour capacity may be obtained for using dry cells. Further, by the switching scheme here provided, it is possible to change the voltage of the battery system at any time without changing the original battery installation in any way. Again, it is possible to connect in

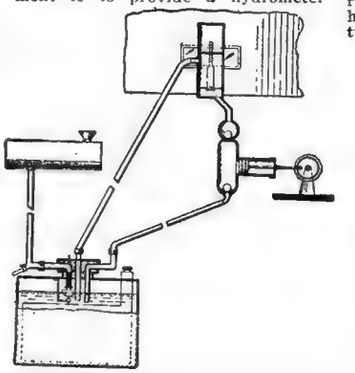


circuit fresh cells for exhausted ones without disturbing the circuit. When the battery system gives out entirely, and becomes no longer possible of manipulation adequate to increase the voltage, anyone not acquainted with the art will be enabled to readily replace old with the necessary new battery cells, and again make the system operative, owing to the simplified connection scheme shown.

Sight Storage Battery Tester.

(No. 1,308,223, issued to Ernest Camp.)

One of the objects of this improvement is to provide a hydrometer

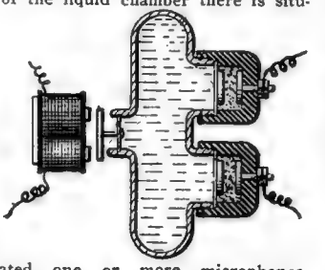


chamber having a connection to the storage battery cell, providing a means whereby the liquid electrolyte may be drawn into the hydrometer chamber, so that the electrolyte may be tested. The testing chamber may be placed upon the dash panel of the car so that the condition of the battery may be examined at any time. A further idea provides a means whereby distilled water may be supplied in small amounts from time to time.

Water Telephone Relay.

(No. 1,306,248, issued to Edward E. Clement.)

At one side of the liquid chamber shown there is placed a diafram actuated by a telephone receiver electromagnet system. At the other side of the liquid chamber there is situ-

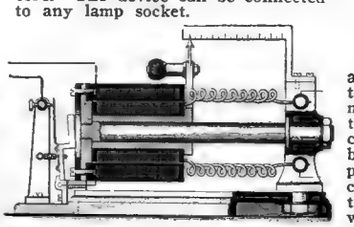


ated one or more microphones. When an incoming sound current passes thru the receiver, it actuates the diafram and corresponding vibrations are transmitted thru the liquid, which may be water.

Induction Coil.

(No. 1,307,093, issued to Benjamin Fulton Gardner.)

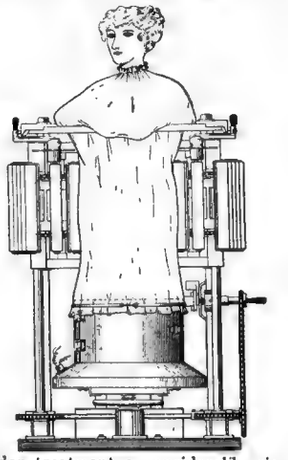
A reversible transformer for the purpose of stepping down or up either alternating current or direct current. There are two coils wound about an iron core and fitted with a vibrator. The outer coil is wound with fine wire and the inner coil is wound with coarse wire, the inner coil being movable along the iron core. A scale is provided so that the strength of the current may be watched as the regulating coil is moved along the core. The device can be connected to any lamp socket.



Electrical Reduction Apparatus.

(No. 1,305,439, issued to William E. Brennan.)

Those having a corpulent form, whether male or female, will be interested in this reducing apparatus invented by Mr. Brennan. One of the principal features of this apparatus lies in the use of an electric heating cell at the base of the structure, in order to give the person

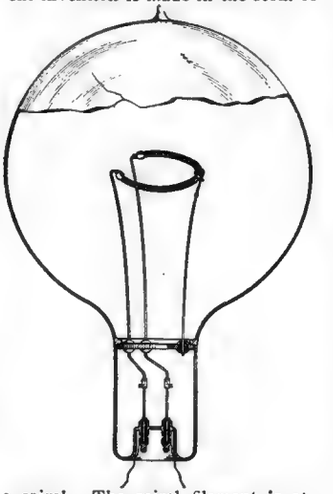


under treatment a considerable rise in temperature while applying the massaging action by means of rotating wooden bars, shown in the illustration. As the inventor points out, any treatment of this nature for reducing the size or weight of a person is much more effective, and the results are more quickly and easily obtained, where the body is heated as well as massaged.

Improved Tungsten Lamp.

(No. 1,306,259, issued to Frederick G. Keyes.)

An improved design for tungsten lamps of high candlepower and suitable for operation on low voltage and high ampereage, in contradistinction to the usual form of high-voltage lamp. One of the features of this lamp resides in the mode of securing proper sealing of the lead wires and the anchors supporting the tungsten filament, which in the present invention is made in the form of



a spiral. The spiral filament is attached at its end to two lead wires made of copper sheathed with iron, the copper being utilized for its good conducting qualities, and the iron being employed for its rigidity, to prevent bending or distortion of the copper wire under the influence of the high temperature developed within the globe.

WITH the AMATEURS

Our Amateur Laboratory Contest is open to all readers, whether subscribers or not. The photos are judged for best arrangement and efficiency of the apparatus. To increase the interest of this department we make it a rule not to publish photos of apparatus unaccompanied by that of the owner. Dark photos preferred to light-toned ones. We pay $5.00 each month for the best photo or photos and $2.00 to each "Honorable Mention." Address the Editor, "With the Amateurs" Dept.

The Editors desire to call to the attention of all owners of "Electrical and Chemical Laboratories" the fact that hereafter the MONTHLY PRIZE WILL BE $5.00 CASH, instead of $3.00. ALSO $2.00 CASH WILL BE PAID TO EACH "HONORABLE MENTION" ENTRY PUBLISHT. We have not received any "Laboratory Photographs" of late. So "go to it" and send us your photo, together with that of your laboratory. If they are particularly good we may list some new and bigger prizes. So get busy, Boys!!! It's up to you. Here's a way to earn some greatly wanted laboratory apparatus at no cost whatever. Don't be afraid to send in too many photos, Boys.

"Amateur Electrical Laboratory" Contest

THIS MONTH'S $5.00 PRIZE WINNER— STANLEY C. REED

HEREWITH are three photographs of my electrical laboratory. I am sixteen years of age and have had my laboratory two years. I have a 6-volt storage battery, two Tesla coils, spark coils, a dynamo and a number of small motors.

I have a fairly complete wireless "Demonstrating Set" with seven-foot aërials, about ten feet apart. The receiving set consists of a coherer outfit and a detector set with a 75 ohm receiver.

I find the study of magnetism very interesting. I have made many magnets, compasses, galvanoscopes, galvanometers and similar instruments. Also my laboratory contains a chemical department in which I test soils, water, and perform other interesting experiments. In my experimental work I am guided by a library of thirty-five scientific books and the ELECTRICAL EXPERIMENTER.—Stanley C. Reed, Lennon, Mich.

HONORABLE MENTION—THEODORE FREDRICK $2.00 PRIZE PAID EACH "HONORABLE MENTION"

HEREWITH I present four pictures of my chemical laboratory, which is very complete, containing all apparatus used in general chemistry. I spend a great deal of my time in qualitative analysis including analysis of foodstuffs, and most everything else. My laboratory contains an electrical rectifier which I have constructed from an article publisht in the ELECTRICAL EXPERIMENTER. I use this in working experiments in electrolysis, such as making potassium chlorat, sodium hydroxid, etc. I have constructed an electric furnace with which I perform experiments in making alloys and castings. My chemicals number about two hundred and fifty, including salts of most of the metals, and I have about one hundred and seventy-five pieces of apparatus. I have also constructed a large Oudin coil, the top of which can be seen under one of the tables. I have performed a great many interesting experiments in high frequency such as described in this magazine.—Theodore Fredrick, 924 Chicago Avenue, Evanston, Ill.

Science in Slang

By EMERSON EASTERLING

"I'M sure glad that station is up and going," remarked Stokes as we motored in from the power plant site.

"I saw a bunch of stuff in the cement houses," put in Punk, "but I'll be flopped if I can make it all out."

"It's more or less a long story," returned Jazz Stokes, "but I'll make it short as possible and still get you birds out of the dark on the subject.

We All Know that Tommy Edison Lost a Lot of Sleep Fiddling Around Over a New Kind of Illumination—the Electric Light. We Used Direct Current then But Nick Tesla Stept In and Gave us "Altering"—Excuse us —Alternating Current.

"We all know that Tommy Edison lost a lot of sleep fiddling around over a new kind of illumination—the electric light—back some years ago. Well, the next thing to do was to make it possible for the neighbors to have the product of his perspiration and inspiration, so he sticks up the primitive central station in the Knickerbocker Burg. The result is that one thing leads to another and now we have 'em all over the sphere.

"Back in the old days they used direct current. Then it was that Nick Tesla steps in and gets disgusted with the layout, kicks out the old stuff and pulls a new one on us. The stunt takes the form of *alternating current.* Nick gets his visionation working and pictures to himself—O, well, anyway he constructs a generator that fools the polarity indicator, and makes it possible for the generator to be farther away from the consumer and yet not have to strain itself to get the juice to the destination."

"How is all this?" asked Bender.

"It's this way," said Stokes, "this alternating current stuff was a new one on the public. The armature in the generator passes thru consecutively opposite magnetic fields and the current therefore goes shooting one way, croaks, and goes flopping back the other way. The speed and number of poles has to do with the frequency of the current.

"Here we put Mike Faraday's induction stuff to some real use. Mike found that if a current be made to pass thru (or over, which way he had it) a wire and another wire be placed parallel, a sort of sympathetic flow will present itself in the second wire; in the other direction. By winding many layers of wire around an iron core—for the iron core makes an easier path for the magnetic flux; the inductive flow is resultant from the induced magnetic field set up by the primary current—of both wires the result is found to be better than to lay the wires stretched out straight. It can be easily seen that the more concentrated flux would act more efficiently than the sparse flux that would course around the extended wires.

"It was found also that if the secondary be wound with smaller wire—more wire being used to make up the mass—that the voltage would be higher in the secondary. If the secondary be wound with larger wire the effect was found to be opposite. All this stuff worked out mathematically to a jot."

The Altering of the Alternating Current

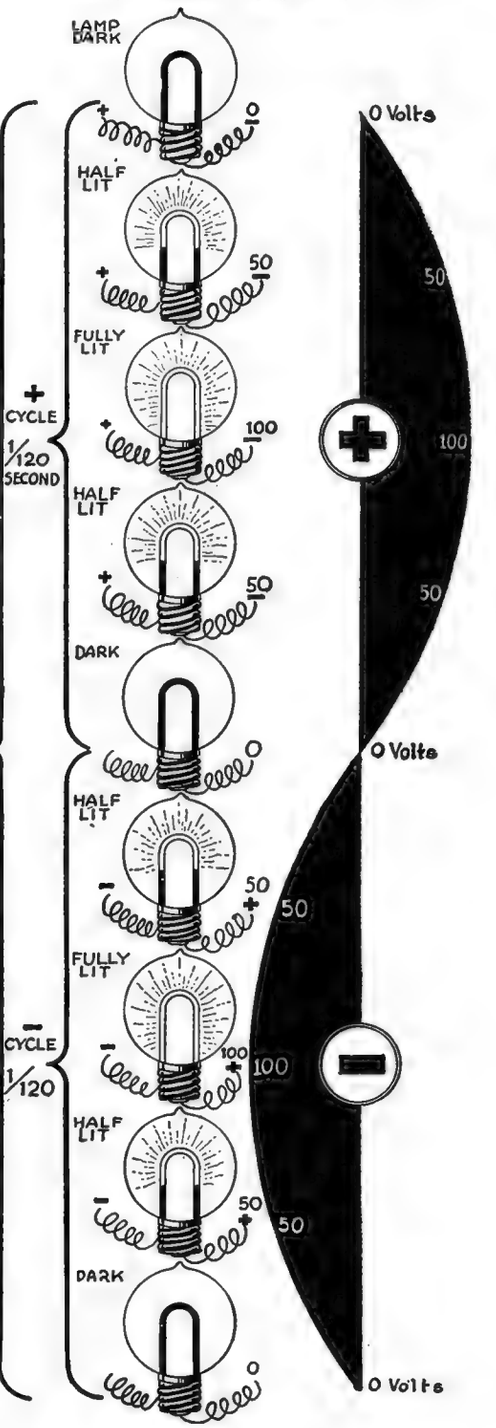
"That all sounds like real spiel," sang out Bender. "But how is it that if the alternating current flops back and forth from positive to negative so many times a second, as you say it does, that we do not perceive any flicker in the incandescent gas bottles, better known as incandescent lamps?"

"Well, as I was going to say," continued Stokes, "several important things happen in producing radiant light from an incandescent lamp after the manner of Tommy Edison's invention. Probably the best way to understand just what happens in the incandescent lamp and why you do not see the flicker when the current pulsation does a one-step, and changes from positive to negative in the twinkling of an eye, is best shown by a drawing." Stokes then took a pencil and pad from his pocket and continued: "Here on the right we have an undulating line known as a *sine wave curve,* and which represents the rise and fall of a single phase alternating current thru two alternations, *or one cycle.* The current at a given instant starts from zero and rises to 50 volts, then 100 volts or 110, whatever it may be, maximum positive value; immediately afterward the positive current impulse starts down hill toward zero again, doing it very smoothly, yet with great speed. The juice makes a complete rise and fall thru *one alternation* or one-half cycle, in 1/120th of a second. Then it passes thru the *dead* or no-current point, also called the zero point, and starts to increase in strength, but in the *negative* (opposite) direction. These negative current pulses, running thru 1/120th second, pass thru the successive rise and fall potentials as you will see, reaching the end once more—this is called *one* cycle by electricians. A cycle comprises two alternations, or a complete reversal from positive to negative. By drawing the various degrees of illumination in the incandescent lamp at different stages thru the cycle, you will at once see how the filament rises from a *dark* condition at the start of a given cycle, increases in temperature and luminosity as the voltage increases thru the *positive* alternation, and finally becomes *dark* again as the current passes thru the first zero point. As the *negative* alternation starts to increase in potential in the next 1/120th second, the filament temperature again rises to a maximum with a consequent full luminosity, and then falls thru successive stages of brilliance until it becomes *dark* once more, as the current passes thru the second zero point at the end of a cycle. This action keeps up repeatedly."

"Yes, that is all very fine," interrupted Bender, "but I don't understand yet, why it is that we do not see the lamp passing thru the dark periods in the cycles. One one-hundred twentieth second is not very fast, and the human eye is supposed to be one of the most wonderful high speed mechanisms in all Nature."

"I was coming to that," bawled Stokes, "if you would have allowed me another minute to catch my breath. Apparently you have forgotten some of your physics, Bender, and on second thought you undoubtedly will agree with me, if you will stop to remember that due to the *retention* of the 'image' on the rod and cone layer of the light sensitive portion of the eye, there is a peculiar action which takes place, causing the image thrown on this element of the eye to be retained for a short but quite appreciable period. Thus it is that

(*Continued on page* 444)



How an Incandescent Lamp Lights Up and Passes Thru the Half Cycle "Dark" Periods When Supplied with "Alternating Current." The "Dark" Periods Are so Short in Time "Duration" that the Eye Does Not Notice Any Flicker.

THE ORACLE

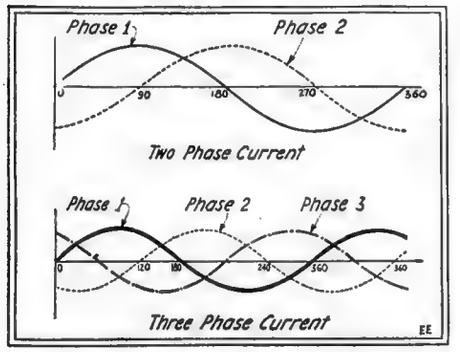
The "Oracle" is for the sole benefit of all electrical experimenters. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, no penciled matter considered.
3. Sketches, diagrams, etc., **must** be on separate sheets. Questions addrest to this department cannot be answered by mail free of charge.
4. **If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable research work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.**

WHAT IS A POLYPHASE CURRENT?

(1020) Paul W. Meradith, Delavan, Ill., asks:—

Q. 1. What is a polyphase current?



Graphic Curves Showing Difference Between Two and Three Phase Currents. A Polyphase Current Is One Comprising three or More Alternating Currents, Spaced Apart on the Time Axis In a Regular and Definite Ratio, Such as Here Illustrated.

A. 1. We must say that this is a very broad subject. You will do very well to consult your library and look up some good works on A.C. current. A very simple explanation, and one which you can readily understand is given in the book entitled, "Alternating Currents—Theory, Practice and Diagrams," by Horstmann & Tousley; also another very excellent work is that entitled "Alternating Currents," by Branch.

We give you herewith illustration showing the relation of the three distinct currents making up a three-phase polyphase system. The three-phase current may be transmitted by six wires or three wires, this system being the usual one in everyday practise. A polyphase current is one composed of two or more distinct, single-phase currents co-acting in a circuit in a certain particular relation to each other. In a two-phase system there are two alternating currents generated in two distinct windings in the alternating-current dynamo; one of these currents is 90 degrees ahead of the other. In a three-phase system there are, as the graph herewith shows, three separate alternating currents generated in three distinct windings on the rotor or stator, as the case may be, of the alternator, and each of these currents is 120 degrees ahead of the other. When one of these polyphase currents enters the windings of an A.C. motor, it sets up a rotating magnetic field of constantly changing polarity, as may readily be imagined, and this drags around the rotor, due to the fact that north and south magnet poles are induced in the iron poles of the rotor, which are repelled and attracted by the suddenly changing north and south magnetic poles of the stator in exactly the same manner as in a direct-current motor.

Your understanding on the subject of D.C. motors most probably makes clear the fact that if it were not for the commutator and brushes connected with the armature or rotor circuit of the D.C. motor, that it could never rotate, and the sole function of the commutator and brushes on such a machine is to suddenly change the polarity of the magnetic poles or fields surrounding the armature, as these poles approach the respective north and south poles of the stationary field.

WANTED!!!

"ODD PHOTOS" AT $1.00 EACH.

Here's what we want! What have you got?

ELECTRICAL PHOTOS—
New photos of Lightning; new and unusual Electrical Apparatus and Machinery; Electric Signs; Electric Autos; Electric Clocks.

SCIENTIFIC PHOTOS—
New Scientific Apparatus; Results; Effects; Motion Pictures; Stunts.

OPTICAL PHOTOS—
Peculiar stunts obtained with various lens arrangements; odd film effects caused by unusual conditions; novel micro-photographic subjects.

ASTRONOMICAL PHOTOS—
New eclipse photos; star and moon effects caught by the camera; comets; shooting stars; progressive moon studies; moon and star photos.

FREAK PHOTOS—
Odd double and triple exposure effects; novel and striking effects due to unusual exposures.

MECHANICAL PHOTOS—
Electrical and Mechanical apparatus of unusual news interest.

RADIO PHOTOS—
New stations, both commercial, government, and private. Owners of private or amateur stations will find a special contest for these photos on another page of this issue. And don't send us plate or film "negatives"; send unmounted or mounted "prints", preferably a light and dark one. Enclose stamps if photos are to be returned and place a piece of cardboard in the envelope with them to prevent mutilation.

Address photos to—Editor "Odd Photos", Electrical Experimenter, 233 Fulton Street, New York City.

ONE-INCH SPARK COIL.

(1021) D—— Brothers, East Lynn, Mass., writes:—

Q. 1. Asking for data on spark coil and underground antennae.

A. 1. Regarding data which you request on underground wireless, we would refer you to the June 1919 issue of the ELECTRICAL EXPERIMENTER wherein you will find a special article by H. W. Secor.

For size of coil which you wish to use with four cells of dry battery, we recommend the following:—

Core about 8 inches long, 1 inch in diameter, properly insulated with a fibre tube having about two to three layers of No. 14 D.C.C. magnet wire wound on same. Over these two or three layers of empire cloth and another insulating tube on top of this, wind about No. 38 S.C.C. magnet wire so as to make the coil about 4 inches in diameter when complete. The coil when operated will give about 1 inch spark.

For information on the construction of spark coils, we would recommend a very excellent book, namely: "Design and Construction of Induction Coils," by Collins, $3.25 prepaid.

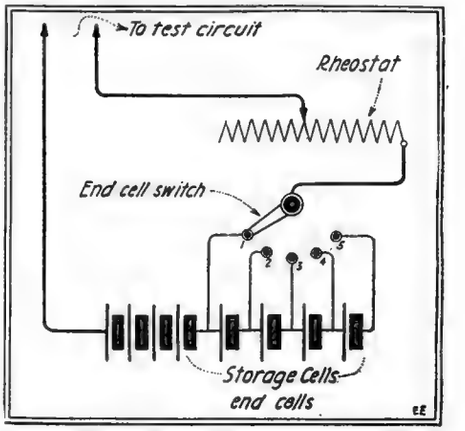
CONSTANT POTENTIAL TESTING CURRENT

(1022)) Oliver V. Austin, Ellisville, Miss., wants to know:—

Q. 1. How can I obtain an absolutely constant testing current from a storage battery?

A. 1. Would say that there is no ordinary method available, to our best knowledge, for maintaining a constant potential from such a source, except by means of a rheostat in the circuit, and also by the provision of a so-called *end-cell switch.*

An end-cell switch is a multi-point switch, connected at the end of the series of cells, and so arranged that as the voltage falls from the battery that other cells one by one can be switched in the circuit, and then the final graduations of potential are compensated for by means of a finely adjustable rheostat connected in series with the battery, as here illustrated.



Method of Obtaining Constant Potential Current from a Storage Battery by Means of an End Cell Switch.

Why Electrical Workers Are Needed.

Consider for a moment what part electricity plays in every-day life, in the comfort, convenience, pleasure and even health of the whole civilized world.

Think of having to ride in horse cars again—

of waiting days for what the telegraph does in a few minutes—

of writing a letter every time you now phone—

of no automobiles or moving picture shows—

Electricity takes millions to and from work. Without it the automobile and airplane would be impossible—the telephone and telegraph would be useless. All the civilized world relies on it for light, heat, transportation and communication. In a thousand ways electricity is used in factories, offices and in the homes.

Electricity is almost as essential as the air we breathe. Business would be almost at a standstill if deprived of its energy.

To say that electricity is still in its infancy is no exaggeration. Every day brings into practical use some new method of controlling it, some new device or appliance for using it. In industrial work there are still scores of operations where electricity will be utilized sooner or later. The day is coming when the railroads will entirely replace steam with electricity. Doctors, dentists and scientists are only beginning to realize the possibilities af electrical energy.

These facts merely touch the high spots, yet they prove beyond a doubt that electricity plays a vital part in business, in our individual lives, and that there is unlimited scope for those who make electricity their life work.

The electrical worker provides other men light to work by, the telephone and telegraph to convey their orders, the power to run their machines and transport their goods. He supplies power in the homes to operate washing machines, vacuum cleaners; for ironing, heating and ventilating. In short, it is the electrical worker who makes it possible for the world to live more comfortably, to enjoy more pleasures and to do a bigger, more profitable business.

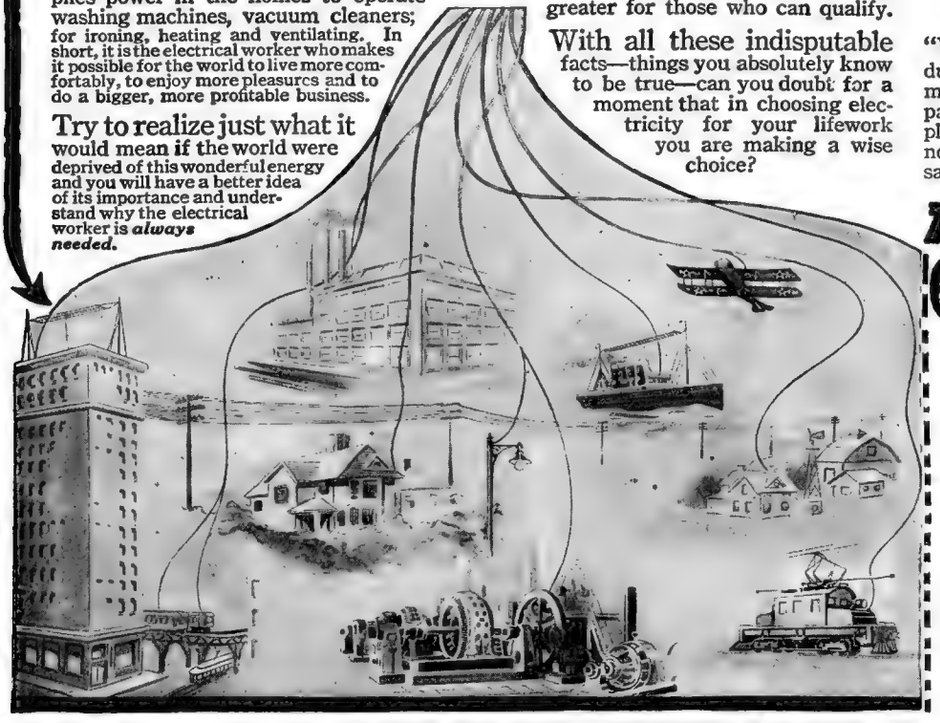
Try to realize just what it would mean if the world were deprived of this wonderful energy and you will have a better idea of its importance and understand why the electrical worker is *always needed.*

What Electricity Offers You

Once you have mastered the A-B-C of electricity you are confronted with unlimited opportunities for advancement. You can specialize in extending and perfecting the wonders already accomplished in the field. You may take up those branches of electrical and mechanical work which cover the design and manufacture of electrical apparatus or start in to qualify for a well-paid position in the designing, construction, operating or consulting branches of the electrical engineering profession, and to fit yourself eventually for a position as Distribution, Operating, Testing, Erecting or Designing Engineer.

In the automobile, airplane, telephone and telegraph lines there is also great scope for the trained electrician. Many wonders of electricity have yet to be unfolded—its uses multiplied—and opportunities still greater for those who can qualify.

With all these indisputable facts—things you absolutely know to be true—can you doubt for a moment that in choosing electricity for your lifework you are making a wise choice?



How You Can Qualify

You don't have to interfere with your present work while qualifying for a good electrical position. The American School can give you just the training you need in your SPARE TIME. Our electrical courses have been specially prepared for home study—are written so you can understand everything quickly—and from your first lesson until you get your Diploma expert instructors coach you. Our training will enable you to get into the game RIGHT.

Read This Guarantee —Then Act

"We guarantee at any time during the first year of your enrollment to refund the entire amount paid if, immediately upon the completion of ten examinations, you notify the School that you are not satisfied with your course."

AMERICAN SCHOOL OF CORRESPONDENCE
Dept. G 266 CHICAGO

TRAINING-THE KEY TO SUCCESS

Please send me booklet and tell me how I can fit myself for the position marked X

..Electrical Engineer	..Automobile Repairman
..Electric Light and Power Superintendent	..Airplane Mechanic
	..High School Course
..Hydroelectric Engineer	..Architect
..Wireless Operator	..Building Contractor
..Mechanical Engineer	..Lawyer
..Heating and Ventilating Engineer	..Business Manager
	..Certified Pub. Acc'nt.
..Sanitary Engineer	..Accountant and Auditor
..Master Plumber	..Bookkeeper
..Civil Engineer	..Gen'l Education Course
..Structural Engineer	..Com. School Branches
..Western Union Course	..Fire Insurance Adjuster
..Telephone Engineer	..Shop Superintendent
..Draftsman and Designer	..Steam Engineer
..Automobile Engineer	..Stenographer

Name.....

Address.....

.....

Diamonds
Watches
Jewelry
Ten Months' Credit

SEND NO MONEY

According to our simple, easy payment plan, we will send you any Diamond for your examination, express prepaid. If satisfied, pay 1/5 of the purchase price and keep it; balance divided into 10 equal monthly payments.

SWEET Diamonds are superior in quality, distinctive in beauty, perfect in cut—gorgeous bursts of radiant splendor. Can be exchanged at a yearly increased value of 7½%. Ask us about this Profit-Sharing Exchange Plan and for YOUR catalog, No. 579P—IT'S FREE.

THE HOUSE OF QUALITY
L·W·SWEET & CO. INC.
2-4 MAIDEN LANE, NEW YORK

$1362 BUYS THE MATERIAL TO BUILD THIS HOME

Improved Sensibly. Cut-to-Fit. Approved by Carpenters. When You Build "THE HARRIS WAY" you build to stay. Exclusive cutting and bundling features—special advantages for the careful Home Builder. It is the best, safest and most sensible way to build your ideal home right, without the waste of a single penny.

LOW PRICE STILL IN FORCE

If you are needing a house, either for investment or for a home, write us.

$10,000 FREE Plan Book

Write today for our beautiful $10,000 HARRIS HOME PLAN BOOK now ready. 100 Designs, with floor plans, prices, etc.; explains how we save 25 to 33 1-3% on finished cost.

Get our FREE Blue Print Plan offer

Write Today

Your protection—Every sale iron clad guaranteed

HARRIS BROS. CO. Dept. CX-412 Chicago

SLIGHTLY USED STANDARD MAKE TIRES

Size	New Tube	Price	Size	New Tube	Price
30x3	$1.85	$ 4.50	35x4½	$3.00	$10.25
30x3½	2.00	5.00	36x4½	3.50	10.50
31x3½	..	5.50	35x5	3.75	11.00
32x3½	2.25	6.00	36x5	..	11.50
31x4	2.75	6.50	37x5	4.00	12.00
32x4	2.40	7.50			
34x4	2.70	8.50	Special—Brand New		
34x4½	2.85	10.00	32x3½, Cord		$12.25

Order now. Shipment made the same day. $1 deposit required with each tire order, balance C. O. D., subject to your examination. Specify whether you desire to have clincher or straight side tire.

Special cash discount of 5 per cent if full amount accompanies order.

CENTRAL TIRE & VULCANIZING CO.,
2309 S. STATE ST., Dept. E. E. CHICAGO

Experimental Mechanics

By Samuel D. Cohen

(*Continued from page* 423)

favor with all users of reamers. The eccentrically relieved reamer is purely a finishing reamer, and cannot be used with advantage to remove any considerable amount of metal. When hand reamers are used merely for the purpose of removing stock, or simply for enlarging holes, the flat relief will undoubtedly prove to be superior to the eccentric. The primary use of straight hand reamers, however, is for producing holes true to size and smoothly finished, removing meanwhile but a small amount of stock. For this purpose nothing excels the eccentric relief. That there are a number of different classes of reliefs required, according to the use to be made of the reamer, is best proved by the fact that while some manufacturers of tools relieve their reamers eccentrically, intending them to be used as finishing reamers, some of their customers place them in a grinding machine and replace the eccentric relief with a flat one, because they find this relief better for their purpose, viz., simply enlarging holes irrespective of the highest requirements of accuracy and smoothness.

A regular cutter and reamer grinder is often used for grinding reamer teeth. See Fig. 5. Another method is to utilize an electric grinder held in the tool post of a lathe, while the reamer is held between the lathe centers. The most economical and best results are obtained when using a grinding machine, made for this purpose. The sharpening or backing off of reamers in a lathe is unsatisfactory and should never be resorted to unless no other means are at hand. Sometimes it happens that a large reamer must be sharpened, the diameter of which is either too long or too short for the capacity of a grinder. In such a case the electric grinder used in a lathe will prove satisfactory. Of course, from the experimenter's point of view, the only means at hand for him to grind his reamers will be the lathe and electric grinder.

The amount of clearance that a reamer tooth should have depends largely upon the class of reamer and its size. A suitable clearance for reamer teeth, exprest in degrees (the face of the tooth being radial), is not a fixt number, but varies for different diameters, and the smaller the reamer the greater the angle of clearance should be. Hence, if the cutter and reamer grinder are set to grind the right amount of clearance on a large reamer, a smaller reamer would not have a suitable clearance at that setting.

(*To be continued*)

How the R-34 Crost the Atlantic

(*Continued from page* 404)

fying audion and sending outfit he has been able to send and receive a distance of 1,200 miles by actual test, he being off the coast of the Azores at the time, communicating with the British Air Ministry at London. The auxiliary outfit is capable of sending 800 miles. In addition to this there is an ordinary spark coil outfit, utilizing but a small amount of current, which has covered a range of 300 miles. This seems rather unique, inasmuch as it is seldom that small spark coil outfits ever cover such a great distance. But according to Lieut. Durrant, it is a fact, and is recorded in the ship's "log." In addition to these outfits there is a "Wireless Telephone" instrument device, which can be connected to the auxiliary wireless outfit, and when so connected, forms a part of this auxiliary outfit, by means of which wireless telephonic communications have been sent and received while in flight.

In back of the Radio Room is the engine room of the forward gondola. This, like the other gondolas, contains a high-powered gasoline engine, which, however, is greatly geared down, the power of each motor being about 275 H.P. An oiler and a mechanic are in charge of these engines constantly, both day and night. Amidships are two gondolas, each of them containing an engine and its respective propeller. The rear gondola has two such engines geared to a single propeller so that either one or both may be operated at the same time. Energy for electric lights is derived by special dynamos each connected to an engine; these dynamos furnish the light for the respective gondolas, and are connected in such a way as to allow any one of them to furnish the electric current thruout the entire ship if necessary. The energy for the wireless station is derived from the main engine. From each gondola there is an aluminum ladder enclosed in a fabric, which leads up into the interior of the blimp. These ladders connect into a passageway so that men aboard the airship may pass from one gondola into another. In the center of the airship there is a large room 20 feet long by 8 feet wide, in which the crew eat, their meals being cooked over the exhaust pipe of the engines. Strange as it may seem the men had bacon and eggs for breakfast on the first day out, cooked as above mentioned on the exhaust pipes of the engine. This shows the terrific amount of heat that these engines, because of their combustion, furnish. Hence each engine has connected with it a very elaborate system of radiators in order to cool it. These radiators are placed above the gondolas as shown in the illustrations.

In the center of the ship there is a runway covered with linoleum, as already mentioned, stretching almost thru the entire length of the keel, i. e., about 600 feet long, and only 9 or 10 inches wide, which the crew use for exercising and for passing from one gondola to another. Should one member attempt to pass the other, either one of them must lean against the aluminum frame-work of the dirigible, so as to allow the other to pass. Should they fail to do this, a drop of about 8,000 feet into the briny deep would result. There is plenty of room to walk upright, the roofs of the gas bags above being about 12 feet from the runway. The gas bags are divided into eighteen separate envelopes, which are inflated with hydrogen, nine of these being equipt with automatic valves so that expanding gases due to changes in temperature may escape. All the bags are incidentally equipt with gages, which register the pressure of gas and are inspected hourly. The hydrogen bags are made of calves' intestines (goldbeater's skin). There are sixteen gasoline tanks attached to the frame-work on either side of the runway, each with a capacity of about 70 gallons, forming a total weight when filled of about 500 lbs. There are forty-nine of these tanks aboard the gondolas and thirty-two in the ship, making a total of eighty-one, more than half of which can be thrown overboard to lighten the craft in case of emergency, which is absolutely necessary inasmuch as there is no way of refilling the

(*Continued on page* 440)

Be a Draftsman
Raise Your Income

Get into this paying profession and have positions opened to you by manufacturers, architects, railroads, contractors—by every kind of a corporation where mechanical design and construction are carried out. Draftsmanship puts you in the class of specialists, raises you above the crowd of job hunters, makes you a man whose services are needed.

You have the same opportunity to get the training that other men had who took the Chicago "Tech" Course in Draftsmanship and are now drawing large salaries and holding important, responsible positions. You also can learn how to earn

$25 to $100 a Week

Not enough really skilled draftsmen are available to fill the places open now. All you need is training to be prepared to answer the call that will mean more money for you. Begin your training without delay. Don't waste time waiting. The Chicago "Tech" experts are ready today to give you the thorough, practical instruction which will enable you to step into the drafting room of some big organization prepared to do the kind of work that earns high salaries and leads to advancement. At least write. Mail the coupon below or a letter stating which branch specially interests you.

Drawing Outfit
(No Extra Charge)

Every student of the Chicago "Tech" Home Study Course in Draftsmanship receives this drawing outfit—set of instruments in case, drawing board, T square, triangles, scale, curve, drawing paper, pencils, etc. or a cash credit in case he already has an outfit. These instruments are of the same make and sizes as used by high salaried experts in drafting rooms of factories, shops, railroads, etc. You use them while learning — then take them right into your practical work.

Come to Chicago "Tech" OR TRAIN AT HOME

Chicago "Tech" has its students everywhere. If you can't come to Chicago, take the Home Study course. The same professors who direct the resident courses will teach you by mail. You will have their personal direction, you will learn the most modern methods—all this while holding your present job. We train hundreds of ambitious men—and see them quickly rise to success. You therefore need not be denied this technical education. Sign and mail the coupon.

Get Practical Training from Practical Men
NO TIME PUT IN ON NEEDLESS STUDIES

Enrollment with Chicago "Tech" means getting direct personal instruction from men who for years have planned and directed big architectural and engineering work in leading cities. They have weeded out useless theories and needless studies and will give you the kind of instruction which will enable you to work beside the most experienced men.

That is one reason why you can get a complete, thorough technical training here in such a short time. Also the reason why Chicago "Tech" men are in such great demand. They go into work prepared to give the kind of service wanted.

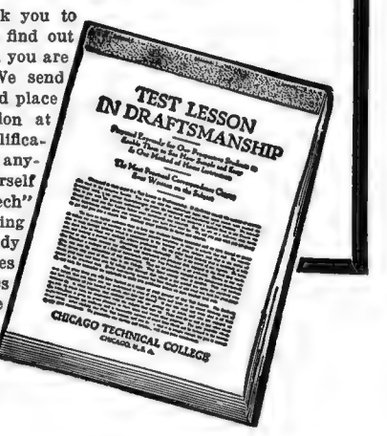
This is the training you are offered either at the college or by mail. And this is the time to enroll when there is such a pressing need for highly trained draftsmen. Use your spare hours to fit yourself for a bigger salary—a more important position. Chicago "Tech" offers you the opportunity. **WRITE.**

EASY PAYMENTS

Low tuition fees and easy terms of payment. Pay as you go along. Get training which will soon repay in extra earnings all the cost of the course. You know the salaries received by skilled technical men today. Get information on the opportunities which you opened wide to you by Chicago "Tech". We will give you all this information about fees, terms, etc., and send testimonials from Chicago "Tech" graduates on how they have profited from our instruction, if you will send the coupon.

FREE TEST LESSON

Other institutions ask you to pay first—and then to find out later how well qualified you are for this profession. We send the free lesson first and place you under no obligation at all. Discover your qualifications before you pay anything. And see for yourself just what Chicago "Tech" offers you in training which will bring a ready market for your services and open opportunities which are closed to the untrained man. The coupon will bring all the facts about the course, the small fee, and the easy terms.



Auto and Gas Engine Course

All about automobile mechanism—its construction, operation and REPAIR—taught by mail. You train directly under the Chicago "Tech" automobile experts. Learn all about Principles of the Automobile, all about Gas Engines, Power Plants, Transmissions, Lubrication, Cooling, Batteries, Starting and Lighting Systems, etc.

KNOW HOW TO FIX TROUBLES

Most complete instruction in auto repair work. Equips you for high pay or to start a business. Big demand for trained repair men.

Aeronautics

Complete, practical instruction in Aeronautic Engineering. Every principle made clear. Construction of every type of machine fully explained. This course equips you for expert work. Get the catalog and information. Send coupon.

WRITE

Below we list our principal courses in Drafting and several others. Just mark X in the [ ] to show which course interests you and we will send catalog and information about that particular subject. If in doubt about yourself, tell us your ambitions and we will advise you. Sending this coupon may mark a turning point in your career. May lead to a larger measure of success than you have expected. We can train you as we have trained others. Send the coupon today.

CHICAGO TECHNICAL COLLEGE
945 Chicago "Tech" Building, Chicago

CHICAGO TECHNICAL COLLEGE
945 Chicago "Tech" Building, Chicago

Without obligation upon me, send your Catalog on subject indicated below. Also FREE Lesson **if inquiry is on Drafting or Plan Reading.**

Mark X opposite work in which you are especially interested.

[ ] Architectural Drafting	[ ] Plan-Reading—Buildings
[ ] Machine Drafting	[ ] Plan-Reading—Shop Men
[ ] Electrical Drafting	[ ] Estimating
[ ] Structural Drafting	[ ] Surveying
[ ] Sheet Metal Drafting	[ ] **Autos and Gas Engines**
[ ] Builders' Course	[ ] **Aeronautics**

Name.....

Address.....

City.....State.....

College or Home Study? State which.....

Book of Styles and Cloth Samples Sent FREE

We Pay Shipping Charges

AMAZING SUIT OFFER!

$17.50

Tailored to Your Measure

Yes—a real $27.50 suit cut and made TO YOUR INDIVIDUAL MEASURE—tailored with all the skill and style that only the best custom tailors can give. Price only $17.50. Finished with highest grade trimmings and linings—the kind that wear and give satisfaction. A special proposition to introduce to the readers of this magazine the wonderful values offered by our system of tailoring. Nothing else like it—no values to equal it.

Our Plan Saves You $10

We have no agents, no dealers, no traveling salesmen. Our catalog is our only representative. Our plan saves $10 or more on every suit and gives you real individuality in your dress. A wonderful selection of fancy wool worsteds, cassimeres and all-wool BLUE SERGES, AT UNHEARD-OF LOW PRICES.

Send only $3.00 and your measurements, with cloth selection made from our catalog. We will make the suit to your measurements and you pay balance on arrival. We take all the risk, you none, for this is our guarantee: Complete satisfaction or all money refunded.

FREE Book of Styles and Cloth Samples

Our big, new Fall and Winter Book is ready for you—contains samples of latest woolens; also lowest prices on men's hats, shoes and furnishings. It is your guide to correct and economical clothes buying. Write, mentioning this publication so we can identify this special offer.

Bernard-Hewitt & Company
424 South Green Street, Desk 349, Chicago, Ill.

SALARY EASILY DOUBLED

STENOGRAPHERS!

Typewrite the New Way—80 to 100 *words per minute guaranteed.* Earn $25 to $40 weekly. Totally new system. Gives speed and accuracy. Learn at home.

If you want more money in your Pay Envelope write for book, explaining the system. Tells how hundreds of NEW WAY graduates increased their salaries $300, $500, $1000 yearly. SEND POSTAL TO-DAY FOR FREE COPY.

THE TULLOSS SCHOOL
3529 College Hill, Springfield, O.

THE NEW WAY IN TYPEWRITING

READ THE CLASSIFIED ADS. ON PAGES 484-486

How the R-34 Crost the Atlantic

(*Continued from page* 438)

bags with hydrogen while at sea. There are three immense drinking water tanks and several water ballast tanks which may be opened to lighten the airship. Everything inside the ship is balanced to perfection, tank for tank, hammock for hammock, and parachutes and life belts for parachutes and life belts on either side. The men eat and sleep in shifts. They sleep in hammocks made of Italian hemp, which are strung from one aluminum strut to another; there are ropes to tie oneself in with. There are ten of these hammocks, three forward, three aft, and two on each side amidships. Two aluminum ladders are connected with the forward and rear gondolas leading between the hydrogen balloonets to the top of the dirigible, where a cockpit opens to the external atmosphere by means of which the observer, taking care not to attempt to stand on the roof while the ship is in motion, takes a "shot" at the sun.

No leather shoes are worn by any of the men around the vessel in order to avoid jarring. Nor are matches allowed inside the envelope at all, everyone using flashlights equipt with miniature electric storage batteries. Inside the ship are found some of the comforts of home, the crew having brought two phonographs to America with them and returning with a third, presented by Mr. Thomas A. Edison. By jabbing a needle into Caruso, they heard him yell all night. In other words, these phonographs were kept going constantly. Lieutenant Durrant asked us not to forget to mention the mascot, a small maltese cat named "Jazz," which he is sure brought them luck on both the journey to America and back home again.

THE AIRSHIP IN MOTION.

The ship is 672 feet long and 150 feet beam at its maximum diameter. The ladders leading to the top are approximately 80 feet high. In order to start the vessel, its moorings are loosened, after which the ship swiftly drifts upward to about 8,000 or 9,000 feet. At this level an equilibrium is establisht and the engines are then started, when the ship proceeds on its course. The speed of the vessel is approximately 49 knots per hour when under full swing with no unfavorable winds, and the men on duty remain at their posts for about four hours, after which they are relieved by another section. For every thousand feet that the dirigible ascends, it loses 1/30th of its volume of gas, and in very heavy foggy weather naturally its normal position would be much nearer to the earth's surface, due to the fact that with a heavier atmosphere it would not be as buoyant.

The ocean viewed from this wonderful craft appears to be a vast blue stretch of prairie, beautifully streaked with green, which is visible thru the rifts in the clouds; every now and then a long white streak forms and rolls along rapidly. Wave motion is not visible at all, but the foam turned up by the wave as it breaks is distinctly noted as the white line of which we have just spoken. On preparing to land, the hydrogen is not allowed to escape, as so many think. The blimp's propellers are kept in constant motion and its rudder is tilted so as to make a nose dive at about a 45 degree angle. Sweeping around the field several times and preparing for a landing place, the vessel comes nearer and nearer to the ground. When all is ready a heavy cable is thrown out from the forward gondola which willing hands immediately grasp, and in addition to this some water ballast is thrown out, giving the landing crew a nice ducking.

While at Mineola, Long Island, the airship was anchored to huge concrete blocks, but because of the terrific resistance such a large body offers to a gust of wind, it broke loose from its moorings, a large hole being torn in its outside envelope. This was repaired in short order, and after that the balloon was held under control by a number of United States soldiers who swung the balloon like a weather vane, so that it continually presented a streamline effect and never broadside to the wind. In this way it was handled for the rest of its stay with no mishap.

An American army portable electric generating station furnished electric current for the searchlights scattered thruout the field, and current for operating the electric gasoline pumps to fill the tanks in the R-34. This outfit represents the latest army type of portable generator, giving about 110 volts and 125 amperes direct current.

Sir William Crookes' Psychical Researches

By Hereward Carrington, Ph. D.

(*Continued from page* 407)

with electricity, and of such a height that it would just fit under the table (see illustrations). Writing of these experiments, Sir William says:

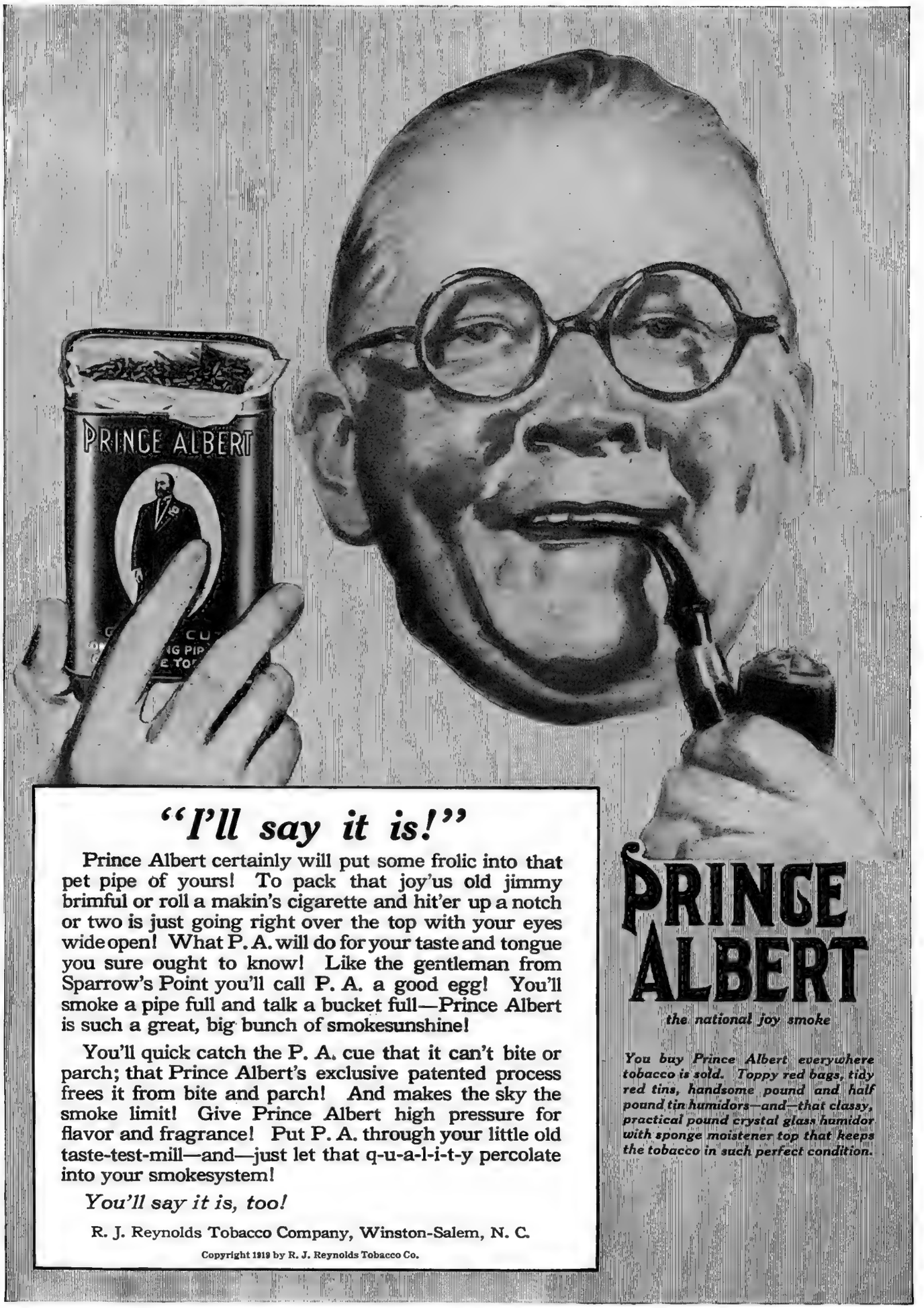
"Mr. Home took the accordion between the thumb and middle finger on one hand at the opposite end to the keys. . . . Having previously opened the brass key myself, and the cage being drawn out from under the table so as just to allow the accordion to be pushed in with its keys downwards, it was pushed back as close as Mr. Home's arm would permit, but without hiding his hand from those next to him. Very soon the accordion was seen by those on each side to be waving about in a somewhat curious manner; then sounds came from it, and finally several notes were played in succession. Whilst this was going on, my assistant looked under the table, and reported that the accordion was expanding and contracting, and at the same time it was seen that the hand of Mr. Home, by which it was held, was quite still—his other hand resting on the table.

"Presently the accordion was seen by those on either side of Mr. Home to move about, oscillating and going round and round the cage, and playing at the same time. Dr. A. B. now looked under the table, and said that Mr. Home's hand appeared quite still, whilst the accordion was moving about, emitting distinct sounds. . . . But the sequel was still more surprising, for the medium then removed his hand altogether from the accordion, taking it quite out of the cage, and placed it in the hand of the person next to him. The instrument then continued to play, no person touching it and no hand being near it."

When Home had hold of one end of the accordion, Sir William Crookes took hold of one of the medium's wrists, and found that *he was not moving a muscle.*

The next experiments were those with a "spring balance." A mahogany board, 36 inches long, was suspended at one end to a balance, supported by a firm tripod stand. See illustration herewith. Any downward pressure upon the board was therefore registered by the spring balance. The other end of the board rested upon a knife-edge fulcrum on a solid table, and directly over the center of the fulcrum was placed a large glass bowl filled with water. Over this, in

(*Continued on page* 442)



"I'll say it is!"

Prince Albert certainly will put some frolic into that pet pipe of yours! To pack that joy'us old jimmy brimful or roll a makin's cigarette and hit'er up a notch or two is just going right over the top with your eyes wide open! What P. A. will do for your taste and tongue you sure ought to know! Like the gentleman from Sparrow's Point you'll call P. A. a good egg! You'll smoke a pipe full and talk a bucket full—Prince Albert is such a great, big bunch of smokesunshine!

You'll quick catch the P. A. cue that it can't bite or parch; that Prince Albert's exclusive patented process frees it from bite and parch! And makes the sky the smoke limit! Give Prince Albert high pressure for flavor and fragrance! Put P. A. through your little old taste-test-mill—and—just let that q-u-a-l-i-t-y percolate into your smokesystem!

You'll say it is, too!

R. J. Reynolds Tobacco Company, Winston-Salem, N. C.

Copyright 1919 by R. J. Reynolds Tobacco Co.

PRINCE ALBERT

the national joy smoke

You buy Prince Albert everywhere tobacco is sold. Toppy red bags, tidy red tins, handsome pound and half pound tin humidors—and—that classy, practical pound crystal glass humidor with sponge moistener top that keeps the tobacco in such perfect condition.

Be a Real Man!

LOOK LIKE ONE AND FEEL LIKE ONE!

BROADEN YOUR SHOULDERS, DEEPEN YOUR CHEST, ENLARGE YOUR ARMS, AND GET A DEVELOPMENT THAT WILL ATTRACT ATTENTION. FILL YOURSELF FULL OF ENERGY AND BE POWERFUL

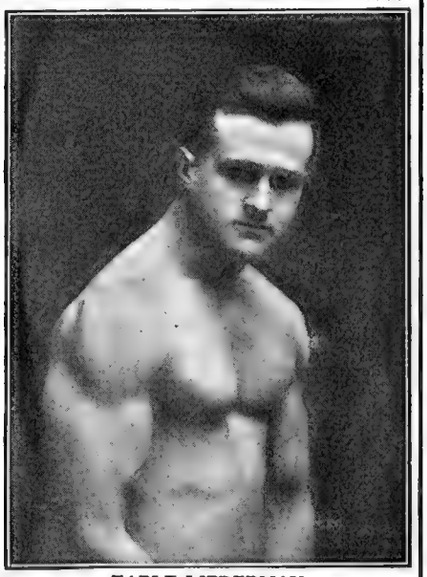
What's the use of merely existing, when you can improve yourself to such an extent that life will become a pleasure.

You don't know what life is unless you are an athlete.

If you are weak, run down, mentally and physically, if you lack ambition or feel discouraged, if you have suffered from youthful errors, or dissipations of later years, if you are bothered with indigestion, constipation, worry, kidney trouble, or any like ailment, *brace up*, and **START IN ANEW, AND MAKE THE MOST OF YOURSELF.**

I can do for you what others cannot attempt to begin to do, because my methods are original with me.

I BEGIN WHERE OTHERS LEAVE OFF.



EARLE LIEDERMAN
The Acme of Physical Perfection

I have trained some of the world's strongest men. If you will let me train you, I can give you a *wonderful muscular development* and great strength as all my pupils have.

I PRACTICE WHAT I PREACH. By my own original methods I developed myself. I keep myself fit.

To make others fit, an instructor should first be fit himself. If an instructor cannot keep himself fit, what good are his methods of training?

HAVE YOU RECEIVED A COPY OF MY NEW BOOK "MUSCULAR DEVELOPMENT"? If you have not as yet read this interesting book, by all means send for a copy. It is handsomely illustrated with 20 full page photographs of myself and some of the finest developed athletes whom I have trained. This book describes my system and you will find it intensely interesting. Send me 10c, stamps or coin, and I will mail you a copy promptly. Simply tear off the coupon below and mail to me with 10c. Do this right now, at once, before you forget it.

EARLE E. LIEDERMAN
Dept. 212, 203 Broadway, N. Y. City

EARLE E. LIEDERMAN,
203 Broadway, New York City.

Dear Sir:—I enclose herewith 10c for which you are to send me, without any obligation on my part whatever, a copy of your latest book "Muscular Development." (Please write plainly.)

Name .....

Street .....

City .....State .....

E. E., Sept., 1919.

Sir William Crookes' Psychical Researches

By Hereward Carrington, Ph. D.

(*Continued from page* 440)

turn, but quite detached from it, being separately supported, was a metal cup, perforated, so as to allow the entrance of the water. The board, thus suspended, weighed six pounds.

It will be observed that by placing the fingers in the metal bowl no added weight was imparted to the board, since this would serve only to displace a small amount of water, which would be registered equally on both sides of the fulcrum.

Mr. Home was asked to place his fingers in the metal bowl, in the water, without touching anything, and requested to *will* the emission from his fingers of the "psychic force," in order to register a depression of the opposite end of the board near the spring balance. He did so, his hands and feet being carefuly guarded (all these experiments being in good light). *A pull of about* 5,000 *grains was registered!* In a number of subsequent experiments, even stronger pressures were measured, which results were permanently recorded by means of a needle, making a graphic tracing of the various depressions and oscillations of the board. The manifestation of some kind of "psychic force" thus seemed to be establisht.

These, however, were but the simple, initial experiments undertaken by Sir William Crookes, which proved to him the reality of "psychic phenomena." His subsequent researches were most striking, including such manifestations as the *levitation or floating in space of the medium's body; the elongation of his body; the movements of objects without contact; playing upon musical instruments without any human hand being near him; the handling of red-hot coals without injury to the medium, and finally (with the medium Florence Cook) full-form materializations, which were seen and photographed by Sir William Crookes, and proved by him to be independent beings, separate from the body of the medium.* Sir William thus enumerates the phenomena witnest by himself:

The movement of heavy objects without contact; raps; the alteration of weight of bodies; movements of heavy substances at a distance from the medium; levitations of tables and chairs, without contact; the levitation of human beings; luminous appearances (lights); the appearance of hands; direct writing; phantom forms and faces; various phenomena indicating intelligence other than that of the medium.

Regarding, for instance, *levitation,* Sir William Crookes says:

"On one occasion I witnest a chair, with a lady sitting on it, rise several inches from the ground. On another occasion, to avoid the suspicion of this being in some way performed by herself, the lady knelt on the chair in such manner that its four feet were visible to us. It then rose about three inches, remained suspended for about ten seconds, and then slowly descended. . . . The most striking cases of levitation which I have witnest have been with Mr. Home. On three separate occasions have I seen him raised completely from the floor of the room. Once sitting in an easy chair, once kneeling on his chair, and once standing up. On each occasion I had full opportunity of watching the occurrence as it was taking place. . . . There are at least a hundred recorded instances of Mr. Home's rising from the ground, in the presence of as many separate persons, and I have heard from the lips of the three witnesses to the most striking occurrence of this kind—the Earl of Dunraven, Lord Lindsay and Captain C. Wynne—their own most minute accounts of what took place. To reject the recorded evidence on this subject is to reject all human testimony whatever, for no fact in sacred or profane history is supported by a stronger array of proofs.

"The accumulated testimony establishing Mr. Home's levitations is overwhelming. It is greatly to be desired that some person, whose evidence would be accepted as conclusive by the scientific world—if, indeed, there lives a person whose testimony *in favor* of such phenomena would be unequivocally taken—would seriously and patiently examine these alleged facts. Most of the eye-witnesses to these levitations are now living (at that time), and would, doubtless, be willing to give their evidence. But in a few years such direct evidence will be difficult, if not impossible, to be obtained. . . ."

Other phenomena recorded by Sir William Crookes regarding the mediumship of Home are still more wonderful. For instance, on a number of occasions, *Home took live coals from the fire, held them in his bare hands, and blew on them until the flames licked between his fingers, and the coal could be seen burning with a fierce heat in his hands.* On several occasions Home asked one of his sitters to touch the coal to assure himself it was hot; he did so, with the result that a large blister was at once raised on the hand. On other occasions, however, Home would apparently communicate his "preternatural incombustibility" to one of the sitters. He would say, "*Now,* touch the coal!" and they would be enabled to do so with the same impunity as Home himself. These phenomena—incredible as they may appear—were vouched for by many witnesses, including Sir William himself, and seem to be among the best-attested of Home's phenomena. The only analogy we have is the so-called "fire walking ceremony" performed in India, Japan, the Fiji Islands, etc.—if we leave out of consideration the historic case of Shadrach, Meshach and Abednego!

Doubtless the most striking tests undertaken by Sir William Crookes, however, were those made with the medium, Florence Cook. These manifestations took place in Sir William's own home—usually in his laboratory—and were of the order of *full form materialization.* Florence Cook, the medium, would enter the cabinet, and apparently go into a state of deep trance. The room being in complete darkness, a white-robed spirit form, claiming the name of "Katie King," would emerge from the cabinet and be seen by the sitters—at times carrying on a conversation with them. Naturally, the question at once comes into the mind: Was fraud possible in this case? Was a confederate employed, or could the medium herself have played the part of the materialized spirit?

It may be taken as certain that no confederate was employed. The tests were conducted, as stated, in Sir William Crookes' own laboratory, and the doors were securely locked before the séance began. No; if any fraud was possible at these times, the medium herself was responsible for it. Could the medium have played the part of "Katie King"?

Writing of this, Sir William says:

". . . Katie is half a head taller than Miss Cook, and looks a big woman in comparison with her. In the breadth of her face she differs essentially in size from her medium, and the photographs show several other points of difference. . . .

"I have the most absolute certainty that

(*Continued on page* 444)

Which Job Do You Want?

NOT one of these jobs is beyond your reach. You can have any one you want. The big pay that goes with it is yours, too. A little ambition and some training that you give yourself at home is all you need. You don't have to serve an apprenticeship. You don't have to go to school. American Technical Society Home Study Books and a little spare time will quickly fit you to hold any kind of job. If you haven't the necessary "know how" to put you in the big pay class, make up your mind to get it right now. Pick out the job you want and send the coupon for the books that will fit you to hold it.

Some of the greatest experts in the world prepared these books just for you—to help you get ahead. They are written in plain, everyday, good old U.S. language, just like you and I talk. No big technical terms—no trouble to understand them. Hundreds of pictures and diagrams in each set help to make difficult things as simple as A. B. C.

Examine Any Books Free

Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was $25.00. Now...$17.80
Civil Engineering, 9 volumes, 3900 pages, 3000 pictures. Was $45.00. Now..... 29.80
Fire Prevention and Insurance, 4 volumes, 1500 pages, 600 pictures. Was $20.00. Now 15.80
Electrical Engineering, 8 volumes, 3800 pages, 2600 pictures. Was $40.00. Now..... 24.80
Automobile Engineering, 6 volumes, 2600 pages, 2000 pictures. Was $30.00. Now..... 19.80
Machine Shop Practice, 6 volumes, 2300 pages, 2000 pictures. Was $30.00. Now 19.80
Steam and Gas Engineering, 7 volumes, 3300 pages, 2500 pictures. Was $35.00. Now...$21.80
Law and Practice (with reading course) 13 vols, 6000 pages, illustrated. Was $72.00. Now 39.80
Telephony and Telegraphy, 4 volumes, 1728 pages, 2000 pictures. Was $20.00. Now... 12.80
Sanitation, Heating and Ventilating, 4 volumes, 1454 pages, 1400 pictures. Was $20.00. Now 13.80
Practical Accounting, 4 volumes, 1840 pages, 800 pictures, etc. Was 20.00. Now..... 12.80
Drawing, 4 volumes, 1578 pages, 1000 pictures, blueprints, etc. Was $20.00. Now..... 14.80

Don't Send Money The coupon alone, properly filled out brings any books you select by express collect. No money to pay in advance and no obligation to buy. **Only 50c a Week**

Use the books as you please for a week and send them back at our expense if you want to. If you decide to keep the books to help you make more money like thousands of other men have done, send us only $2.00 each month. This is only 50 cents a week.

Extra Special FREE OFFER Those who send the coupon promptly will be enrolled as a consulting member of our Society for one year. This gives you the privilege of consulting our engineers and experts on any problem connected with your work—**Free of any charge.**

Go after one of these big jobs now. This is the time. Trained men were never more needed than they are today. This coupon is your start on the road to real success. **MAIL IT NOW.**

American Technical Society
Department X-256 Chicago

REDUCED PRICE COUPON

American Technical Society, Dept. X-256, Chicago

Please send me set of..... shipping charges collect. I will examine the books thoroughly and if satisfied, will send $3 within 7 days and $2 each month until I have paid the special price of..... If I decide not to keep the books, I will return them by express at your expense. Title not to pass to me until the set is fully paid for.

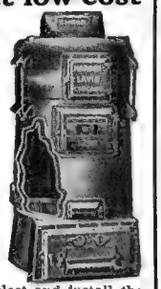
Name.....

Address.....

Reference.....

DO Your Own PLUMBING AND HEATING at low cost

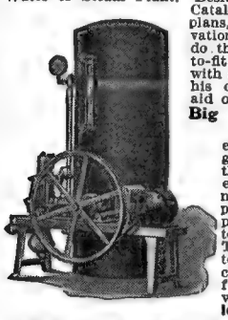
Send for our big instructive 256 page well-bound Handy-Man Book Catalog. Every Home Owner, Contractor, Electrician, Farmer, Factory Manager, etc., needs it. Shows over 10,000 Fixtures and Supplies in plumbing and heating at wholesale. Shows how to save skilled labor, hard work and unnecessary material by



OUR NEW

Cut-to-fit-Method

This wonderful book helps you select and install the proper Plumbing, Water Supply System, Hot Air, Water or Steam Plant. Besides being our Wholesale Catalog it has many practical plans, diagrams, sketches, elevations, etc., showing how to do the work this newer, cut-to-fit way. Any handy man with a few tools can easily do his own installing with the aid of this



Big Handy-Man Book

We have spared no effort and have gone to a great expense to compile this valuable book. With economy still a national necessity, it would be unpatriotic to send this expensive book broadcast to non-interested parties. Therefore, we request a temporary deposit for each copy of 25c which we refund on first order, or we send our **Bargain Bulletin Free.** Address Today

HARDIN-LAVIN COMPANY
40 Years At
4510-20 Cottage Grove Ave., Chicago
$500,000 plants behind our guarantee

Become a Doctor of Chiropractic

SUCCESS

Implies Health, Wealth, Happiness

All of these desirable and necessary conditions to a life of success can be attained thru CHIROPRACTIC.

However, to attain success in any important profession requires thorough preparation thru RESIDENTIAL INSTRUCTION. Chiropractic is rapidly gaining recognition in every state and only graduates of Standard Schools and Colleges are allowed examinations. Correspondence courses are inadequate to meet the requirements, therefore, the road to success in Chiropractic leads thru residence courses only.

Length of course, tuition cost are yet moderate.

Write for full particulars & booklet 59

N. Y. College of Chiropractic
1416 Broadway, New York City
Tel. 6956-7 Bryant

Write Secret Letters With Invisible Ink

Pour seemingly plain water into three glasses and have it turn red in one, white in another and blue in the third! Make your own magic writing paper, and blue ink or ink powder. Write with plain water and have the writing turn blue. You can surprise and puzzle your friends with these and more mysterious and amusing Chemical tricks, if you have "CHEMCRAFT" Junior—the boys' miniature chemical outfit. Send 25c for your outfit right now, it's the greatest fun-maker you ever had. Send at once and get a Free copy of "The Chemcraft Chemist," an interesting magazine for boys.

Amateur Chemist's Catalogue and Hand Book
containing much valuable information for Boy Chemists and listing many useful chemicals and apparatus, sent postpaid for 10c. None free. Regular "CHEMCRAFT" Chemical Outfits, $1.50, $2.00 and $3.00.

THE PORTER CHEMICAL CO.
Hagerstown, Maryland

CHEMCRAFT JUNIOR 25¢ POSTPAID

INSYDE TYRES Inner Armor
for Auto Tires. Double mileage, prevent blow-outs and punctures. Easily applied in any tire. Thousands sold. Details free. Agents wanted.
Amer. Accessories Co., Dept. 83, Cincinnati

Sir William Crookes' Psychical Researches

By Hereward Carrington, Ph. D.

(*Continued from page* 442)

Miss Cook and Katie are two separate individuals, so far as their bodies are concerned. Several little marks on Miss Cook's face are absent on Katie's. Miss Cook's hair is so dark a brown as almost to appear black; a lock of Katie's, which is now before me, and which she allowed me to cut from her luxuriant tresses, having first traced it up to the scalp and satisfied myself that it actually grew there, is a rich golden auburn. . . .

"One evening I timed Katie's pulse. It beat steadily at 75, whilst Miss Cook's pulse a little time after was going at its usual rate of 90. On applying my ear to Katie's chest, I could hear a heart beating rhythmically inside, and pulsating even more steadily than did Miss Cook's heart when she allowed me to try a similar experiment after the séance. Tested in the same way, Katie's lungs were found to be sounder than the medium's, for at the time I tried my experiment Miss Cook was under medical treatment for a severe cough. . . . ."

Sir William Crookes also took a number of flashlight photographs of Katie—one showing her standing beside him, and one showing Miss Cook, entranced, in the cabinet, with Katie, the materialized spirit, beside her. These phenomena, incredible as they may appear, were nevertheless seen and testified to by a large number of responsible people, and were observed by Crookes himself for many weeks consecutively, and tested in every way possible. These phenomena are among the most extraordinary in the whole history of spiritualism—the most incredible, *and the best attested!* What are we to think of them? That is the question which has been asked for the past half century, and which still remains unanswered! They are the most startling manifestations which Sir William Crookes reported, and will remain forever associated with his name.

In the next issue, "Apparatus Used in Exposing Fake Spiritualists." Another interesting discussion by Dr. Carrington.

Science in Slang

By Emerson Easterling

(*Continued from page* 435)

the eye tends to retain an impression of the filament at full or nearly full luminosity, while the current passes thru zero and the temperature of the filament proper decreases rapidly toward zero. Hence, before the image of the illuminated filament thrown on the eye is lost, insofar as its effect on the optic nerve is concerned, the current and filament temperature has past safely thru the zero point of the style, and started to rise again on the reversed current pulse of the cycle, as I showed you previously.

"As high voltage currents transmit with more efficiency and low voltage currents are more conducive to longevity when placed within reach of the uninitiated consumer, it was found that alternating current would have to neither be partial to the transmission nor the consumer, so the juice peddlers stick in the A. C. generators and hang pots (transformers) to step up the juice for better transmission, and then step her down for the consumers' better health, disregarding the undertakers' scowls."

"That is a pot," Bender said, pointing to a cast iron object on an electric light pole, and looking over at Jazz to see if he was going to censure the statement.

"Yes," replied Punk, "I have noticed them on a number of telegraph poles."

"There is a funny thing," laughed Stokes, "to the general public a pole is a pole—whether telephone, telegraph, light, or power. There is as much difference as there is in nigger, chink, white, or Eskimo. One of the most apparent differences would be found out if you should happen to try to tap in on a high tension transmission line to get the Tia Juana results."

"How is the stuff worked?" asked "Bonehead" Florey. "How is the juice sent from the station where the stuff is manufactured to the kitchen range or cigar lighter?"

"The stuff is first stept up, as I said, then it is stept down somewhat by a substation, generally in the outskirts of the village that the juice is being pumped into. The idea is that 4,000 volts is less likely to cause a massacre if the lines blow down than 66,000, 33,000, 20,000, or the like; so they step it down. Four thousand will transmit the distances from most substations with more efficiency than would the higher voltages—they figure that the line loss is more desirable than the life loss. Some companies step the voltage down to 2,300 again, or direct from the sub-station. Laws, ideas, and convenience have to do with the voltage.

"Then again, the *three phase* effect that the A. C. made possible has put that form of service over the direct current way in practically all power work. The three phase motors have first place in efficiency, you know."

"What is three phase?" asked Bender.

"In alternating currents we have *single phase* currents. The working of the current is generally described on paper by drawing a straight horizontal line representing zero—no current. All above the line is current in one direction, say positive. All below the line negative. The vertical distance from the line represents the height of the voltage. The voltage in a single phase current under ideal conditions would describe a continuous reversed curve, a semi-circle above the line and a semi-circle below the line. It will be seen then that the potential raises from zero to the maximum and to zero, thence to maximum in the other direction. You see the effective voltage is not the maximum voltage, for part of the time there is no flow in the circuit, and part of the time there is more than is recorded on the voltmeter. I guess that explains the single phase.

"Then in actual practise we have *two* and *three phase* alternating currents. In the two phase when one circuit is dead, the other is making an impression on the line. In the three phase each wave comes up just as the other is dying and keeps up the 'racket' in a much better manner than is possible for the intermittent single phase, or the two phase."

"And a volt is the pressure on the circuit. An ampere is the rate of flow. The volts times the amperes equals the watts. One thousand watts equals one kilowatt," rambled on Punk. Then turning to Stokes, "Isn't that right?"

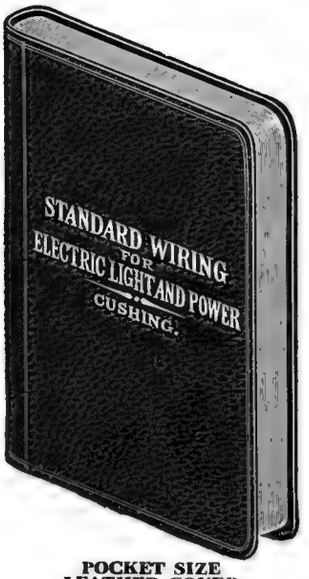
"Right," responded Jazz, "and the juice peddlers stick you up so much per kilowatt——"

"Yes," interrupted Bender, "too much."

All You Need to Know About Wiring

Is In This Latest Edition of "STANDARD WIRING"

It Will Make You An Expert Wireman



POCKET SIZE
LEATHER COVER

GENERATORS—How to install them, care for them and operate them; all their troubles and how to prevent and cure them; all diagrams showing connections for compound, series and shunt wound machines. How to operate them in parallel or in series. How to protect them and wire them in accordance with the underwriters' requirements.

MOTORS—How to install them, how to protect and operate them. The required amperes, volts or horse power when any two factors are known. How to take care of hot boxes, sparking commutators and other troubles. How to change the direction of rotation when desired. How to start and stop any kind of motor in any class of service. All diagrams of motor wiring. How to find the proper size of wire for any motor for direct current or for A. C. single, two or three-phase.

OUTSIDE WIRING—Pole line construction, line wires, service wires, roof structures, poles and their dimensions and weights, and how to erect and protect them and wires they carry. Insulators, guard arms, guy anchors. Tree wiring, splicing, service and entrance wiring. How to install Lightning arresters. Transformers with diagrams and instructions.

INSIDE WIRING—when and where to use rubber covered, slow burning and weatherproof wire. How to find the proper size of wire to use for lamps, motors or heating devices for any current, voltage and drop, either by formula or by the many tables that are given in this section of the book. How to wire for two-wire or three-wire systems. Direct current, two-phase and three-phase with formulae and tables, with examples worked out for each system and in a simple manner that anyone can understand and use. How to run wires on walls, ceilings, floors, through partitions and walls and in concealed places, damp places and where dangerous surroundings exist. When and where to install Switches, Cut-outs and Circuit Breakers and just how to do it. How to wire for high and low voltage systems and the precautions to be taken. The proper way to install Knife and Snap Switches, Cabinets and Cut-out Boxes, Outlet, Junction and Switch Boxes, Panel Boards, Wooden and Metal Raceways. How to install complete interior conduit jobs either for rigid metal, flexible metal or flexible non-metallic conduit. Concealed knob and tube work or armored cable. How and where to install and wire electric and combination lighting fixtures. How and where to use flexible cord and where not to use it. How to install arc lamps and gas filled lamps and the fixtures and rules required.

LIGHT AND ILLUMINATION—What is meant by proper and efficient illumination, the latest data on Mazda and gas filled lamps of every candle power and wattage. Direct, indirect and semi-indirect illumination and where each should be used. Illumination required for various classes of service from show window lighting to public halls and from factories to small residences.

TABLES—Fifty-two tables giving every dimension, carrying capacity, resistance, weight and strength of every size of wire and cable of copper, steel and iron.

All the necessary dimensions, capacities, weights, and other data on conduits, fuses, insulators, lamps, sockets, motor efficiencies, current per horse power of motors. Electrical units and their equivalents. Proper size of wire for all classes of power, light and heating installations. The proper symbols to use to indicate on plans just what is wanted from a motor to a small snap switch with all necessary diagrams.

APPARATUS AND SUPPLIES—A classified list of the leading manufacturers of officially approved wires and wiring devices. Engines, generators, motors, appliances, fixtures, and all supplies necessary for any complete installation from a Central Station to a small cottage.

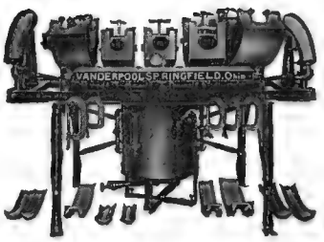
The most complete and accurate Book on Wiring and Construction published

350 PAGES - LEATHER COVER - POCKET SIZE, $1.50

Sent Postpaid to Any Address on Receipt of Price by

H. C. CUSHING, Jr., 10 West 40th St., New York

Every Electrical Inspector in the United States will approve your work if done in accordance with the simple rules given in "Standard Wiring"



Big Money and Independence for Life

Here is the most profitable business on earth — TIRE REPAIRING. Open a Tire Repairing Shop—business pours in. We are the pioneer manufacturers of the Dry Cure Vulcanizer—the only vulcanizing that guarantees absolutely PERFECT work. Write at once for FREE TIRE REPAIRING MANUAL and full particulars.

In answering address Dept. U-14.

Wm. Vanderpool Co. Springfield, O.

Bewitching Pictures!

Exact reproductions from original Photographs, already for mounting and framing. If you are a lover of the beautiful in art, here is just what you have long wanted. For a short time we make a special introductory offer, as follows: **Send 25c and we will send you eight selected beauties** and our beautifully illustrated catalog. After seeing the samples you will want more.

PARIS NOVELTY COMPANY
Dept. P. 1, 26 E. Adams St. Chicago

Big Band Catalog sent free

Whatever you need—from a drumstick to the highest priced cornet in the world. Used by the Army and Navy. Send for big catalog; liberally illustrated, fully descriptive. Mention what instrument interests you. Free trial. Easy payments. Sold by leading music stores everywhere.

LYON & HEALY
57-69 Jackson Boulevard, Chicago

ONLY 35c

Cut Your Own Hair WITH THIS SAFETY HAIR CUTTER

If you can COMB your hair you can cut your own hair with this marvelous invention. Cuts the hair any desired length, short or long. Does the job as nicely as any barber in quarter the time, before your own mirror. You can cut the children's hair at home in a jiffy. Can be used as an ordinary razor to shave the face or finish around temple or neck. Sharpened like any razor. Lasts a lifetime. Saves its cost first time used. **PRICE ONLY 35c, postpaid. Extra Blades 5c each.**

Taylor, Barnard & Co., Dept. H. I. 24 E. Adams St., Chicago, Ill.

READY MONEY

when you want it and as much as you wish to earn. Cover your territory for us. Spend only a few hours a day or devote all your time, whichever you prefer. Send for our plan at once.
Experimenter Pub. Co., 233 Fulton St., N. Y.

ZIP-ZIP Patented Sept. 3rd, 1918

The Greatest 50 Ct. Article on the Market. Shipped right from the factory the same day we receive your order. The Prong is made of beautiful metal; never break or wear out; scientifically made and best workmanship. The rubbers are elastic and lasting, with plenty of pep and force. Zip-Zip, complete, only **50c** prepaid. Be sure the name Zip-Zip and our address appear on the article you buy. Order from us or any Sporting Goods Store in your city. Send Stamps, Coin or Money Order.

AUTOMATIC RUBBER CO.
COLUMBIA, S. C.

POPULARITY FOLLOWS THE **UKULELE**

If you play quaint, dreamy Hawaiian music or latest songs on the Ukulele you will be wanted everywhere. We teach by mail 20 simple lessons; give you free a genuine Hawaiian Ukulele, music, everything—no extras. Ask us to send the story of Hawaiian music. You will love it. No obligation—absolutely free.

The Hawaiian Institute of Music
1400 Broadway, Dept. 51, New York

Speeding Up the Airship

(*Continued from page* 397)

equally light gas, which we do not know of as yet.

On its first visit to the United States, the R-34 proved beyond controversy that the natural element of the dirigible is the air. As long as an airship remains from 300 to 500 feet above the surface of the earth it is comparatively safe, and at this level it will be possible for it to ride out any storm. The airship in this instance is not any different from the steamship, which can ride out any storm, as long as it is in the open ocean. What the steamship fears is the proximity of land or reefs, which usually spell its doom.

The future airship will not land its passengers by coming down to earth, any more than the steamship lands its passengers by climbing upon dry land. The airship will be fastened to earth by means of long thin steel cables from 200 to 500 feet long, and only one or two of these cables are needed; they will probably be attached to either the center or the nose of the airship. The passengers will then be landed by means of a landing passenger and freight elevator built into the airship, as described in our article in the July issue. This idea is also depicted in the above illustration, which shows the portable elevator built into the airship.

Making a Machine for Telegraphing Pictures

By Leroy J. Leishman

(*Continued from page* 421)

of its shaft by about 4 inches. The width of the base should be 8 or 9 inches. It is inadvisable to make these bases from metal, as short-circuits are too liable to occur. Wood is good enough.

Five holes are to be bored in each base as indicated in Fig. 2. A and B are for binding posts. C should be a small hole to accommodate a piece of annunciator or magnet wire. D and E should be large enough for two flexible cords such as that used for light drops. Do not bore E until the machine is practically completed for reason that will be apparent later.

The uprights A (Fig. 1) that support the cylinders must be made of metal. They can be triangular shaped, and should have half an inch of the lower edge turned up to a right angle for affixing to the base (see B, Fig. 1). From this angle to the hole which is to be bored at the top for the cylinder shaft the distance must be at least a half inch more than the radius of the cylinder. The holes in these *must be bored exactly the same distance from the bottom, so that the cylinder will be supported absolutely level.*

The cylinder should be mounted close to the opposite edge of the base to that near which the holes were bored for the binding posts. The binding posts are at the back of the machine, and the cylinder at the front. Mount the cylinder and shaft so that the cylinder comes about 3 inches from the end of the base, leaving about 1 inch between the end of the rod and the other end of the base. One support should be placed against the cylinder and the other about 1 inch from the end of the shaft (see F and G, Fig. 2). Screw the supports in place so that the cylinder is parallel to the edges of the base, and then place the cylinder rod thru the holes provided for the purpose. If Meccano or Erector material is used, collars can be obtained for keeping the cylinder and other parts in place.

Now get a cold-rolled steel rod about 3 inches longer than the cylinder and about ¼ inch in diameter. Have this threaded within a half inch of one end and an inch of the other. No particular pitch is essential, as the progress of the carriage can be governed by other means. The unthreaded ends must now be turned down to the same size as the cylinder rod, so that the same make of gears or pulleys will fit. Then secure a rod about a half inch shorter than the threaded shaft. This rod can be of the same diameter and material as the cylinder shaft.

The height of the supports for these will vary with the material at your disposal for the carriages, which can be made from ordinary telegraph sounders by soldering an extra piece on the end of the arm where the spring is attached. This piece can be the same width and thickness as the original arm of the sounder, but must be at least 3/16 inch square. The length will be dependent upon the diameter of your cylinder and the way the sounder is mounted on its own base. Hold the sounder level and at the same height as the cylinder rod, keeping the end of the sounder with which we are concerned toward the cylinder and the base of the sounder at least ½ inch behind the cylinder. The addition to the arm must be long enough to extend about ⅛ inch beyond an imaginary line perpendicular to the base of the whole machine and extending thru the center of the cylinder when the carriage is held in this position. The phonograph needle, to be placed in the end of this extension arm, will then touch the cylinder right at the top. Drill a hole the size of a steel graphophone needle down thru this extension arm about ¼ inch from the end, when measured from the top, and slightly less than 3/16 when measured from the bottom, so that the needle will set at an angle of thirty or forty degrees. As the needles must be changed, a thumb screw (H, Fig. 2) should be placed in the right side of this arm to hold the needle in place. A Victor or Columbia graphophone thumb screw is satisfactory, and most phonograph repair shops have taps to thread holes to fit.

If you do not have two sounders—one for each machine—the essentials for making the carriage are merely the needle arm, the fulcrum, a pair of electro-magnets, a bar for the magnets to attract, a coiled spring, and a stop to prevent the arm from moving too far up or down.

Under the front of the carriage, near each side, some sort of threaded half-nut arrangement must be provided. It is satisfactory to use a couple of pieces of tin with the edges turned down and slotted approximately to fit the screw or threaded shaft. Place one at each side. Under the back of the carriage two screw eyes can be used for the guide rod to pass thru.

The height of the uprights or supports C (Fig. 1) for the guide rod D and threaded shaft E can now be determined. They should hold these rods at a height which will support the carriage so that the end of the phonograph needle in the end of the arm will touch the cylinder when the arm is in its downward position. These supports can be made of metal, like those for the cylinders, or else from wood. Separate supports can be made for the screw and rod, or else double supports with two holes. *The screw and rod must be absolutely parallel, otherwise the carriage will catch or bind.* They must also be parallel to the cylinder, but not necessarily in the same plane. This means that great care must be taken in boring the holes in the uprights so that the screw and rod will be not only the proper distance from each other, but absolutely the same distance from the base thruout. Be sure, therefore,

(*Continued on page* 448)

Camel CIGARETTES

18 cents a package

CHOICE QUALITY
20
Don't look for premiums or coupons, as the cost of the tobaccos blended in CAMEL Cigarettes prohibits the use of them.
MANUFACTURED BY R. J. REYNOLDS TOBACCO CO.
WINSTON-SALEM, N. C. U. S. A.

Smokers realize that the value is in the cigarettes and do not expect premiums or coupons!

Camels supply cigarette contentment beyond anything you ever experienced! You never tasted such full-bodied mellow-mildness; such refreshing, appetizing flavor and coolness. The more Camels you smoke the greater becomes your delight—*Camels are such a cigarette revelation!*

Everything about Camels you find so fascinating is due to their quality—to the expert blend of choice Turkish and choice Domestic tobaccos. You will prefer this blend to either kind of tobacco smoked straight.

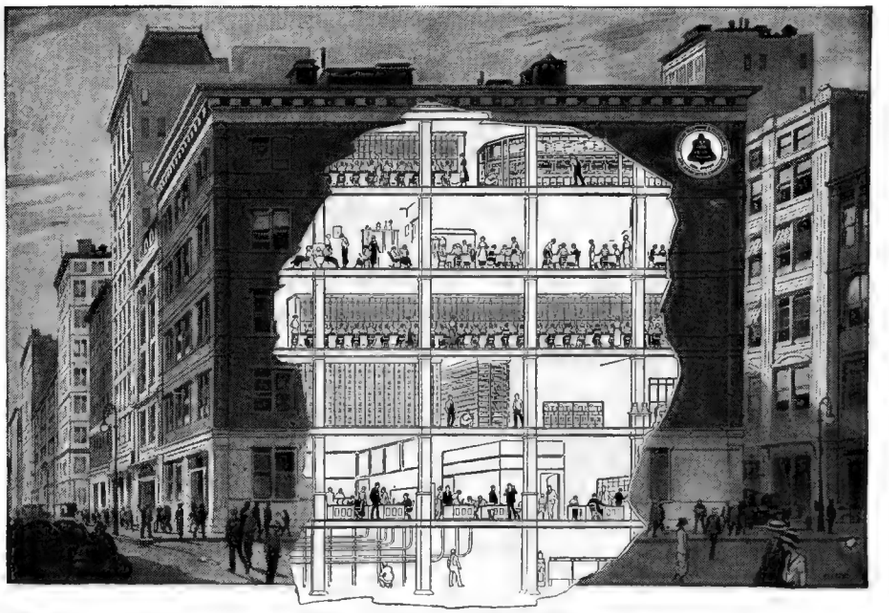
You'll say Camels are in a class by themselves—they seem *made to meet your own personal taste* in so many ways!

Freedom from any unpleasant cigaretty after-taste or unpleasant cigaretty odor makes Camels particularly desirable to the most fastidious smokers. And, you smoke Camels as liberally as meets your own wishes, for they never tire your taste! You are always keen for the cigarette satisfaction that makes Camels so attractive.

Compare Camels with any cigarette in the world at any price!

R. J. REYNOLDS TOBACCO COMPANY, Winston-Salem, N. C.

Camels are sold everywhere in scientifically sealed packages of 20 cigarettes or ten packages (200 cigarettes) in a glassine-paper-covered carton. We strongly recommend this carton for the home or office supply or when you travel.



The Great Task of Construction

With the coming of peace the Bell System faced an enormous construction program. Conditions arising from war resulted in the wiping out of the reserve equipment normally maintained, and necessary to give prompt connection to new subscribers. The release of industry and accumulated growth of population now makes telephone demands almost overwhelming.

Telephone construction, including buildings, switchboards, conduits, cables and toll lines, must, from its inherent nature, be undertaken in large units. A metropolitan switchboard, with its tens of thousands of parts, may require from two to three years to construct and install.

Only great extension can meet the present excess burden of traffic and provide for future requirements. Extension which cares for immediate demand, only, is uneconomical and calls for continuous work of such a character as to be frequently detrimental to the service.

During the war the Bell System devoted all its margin to the needs of the Government. The great task of getting back to normal pre-war excellence of operation requires the reestablishment of an economic operating margin capable of taking care of a larger growth than has ever before confronted the Bell System.

Construction is being pushed to the limit of men and materials; while every effort is being made to provide the best, present service.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

CARNOTITE

(Radium Mineral.) The American Pitchblende found in Colorado, from which *Radium* is extracted.

A generous piece, enough to conduct experiments, such as affecting photographic plates thru opaque material (similar to X-Ray pictures), first made by Sir W. Crookes and Mme. Curie, is furnished in neat, wooden box.

URANIUM ORE (*Radio-Active*)

Containing about 35% of pure Uranium; also Radium and Vanadium. One of the most rare and interesting minerals. Twenty milligrams are furnished in glass vial protected by lead cover.

One box of *Carnotite* and one vial of *Uranium Ore* as described above 50c sent prepaid.

FORMULAS

Luminous Paint—Silver Plating Powder—Liquid Court Plaster—Soap Bubble Liquid—Straw Hat Bleach—Collapsible Tube Tooth Paste—Resilvering Mirror Liquid—Polish for Tan Shoes—Dressing for Tan Shoes—Paint to make Oil Cloth.

These Ten Recipes in sealed envelope for 50c. Sent prepaid.

SIDNEY SPECIALTY CO., 233 Fulton Street New York City

Making a Machine for Telegraphing Pictures

By Leroy J. Leishman

(*Continued from page* 446)

that the rod and threaded shaft are straight. Mount these so that the rods extend the same distance beyond each end of the cylinder, and so that the front of the mounted carriage comes about ¼ inch behind the cylinder with the needle at the top of the cylinder directly above its center.

The only place in the whole set of machines where pulleys can be used instead of gears is in connecting the threaded shaft and the cylinder. The pulley I (Fig. 2) for the screw must be larger than the one on the cylinder rod, the exact size depending on the pitch of the threads and how dark or light you may desire the telegraphed pictures to be. The cylinder should make from 60 to 120 turns while the carriage travels 1 inch. After the pulleys are placed on the rods and lined up, put on a cord, elastic band or spiral spring for a belt.

It is essential that the cylinders of both machines turn as true as possible. If they do not do this, bend the rods till they are as perfect as you can make them.

Hole E (Fig. 2) should now be bored about a half inch behind the guide rod D (Fig. 1) and J (Fig. 2), and midway between its two ends.

After both machines are this far completed, they may be wired. Get a piece of flexible fixture cord and cut two pieces about 2 feet long. Peel the ends and scrape the strands of wire till they shine. Inasmuch as it is difficult to tell which one of the wires you want after they are drawn thru the base, it is best to twist both ends of one of the wires in such a way that it will be recognized from the other. Put a pair of these wires thru hole E in the base of one machine, and use the other pair in like manner for the other instrument. Attach one wire to the terminal of the magnet windings on the carriage, and also ground it so that it is electrically connected to the metal arm bearing the phonograph needle. Connect the other end of the same wire to one of the binding posts. The other wire should be connected to the other side of the carriage magnet windings, so that a current in both wires will energize the magnets and lift up the needle. The remaining unconnected end of these wires should be drawn thru hole D (Fig. 2), where it is to be connected to the right side of a two-way battery switch G (Fig. 1). The slack in this wire should be pulled above the base to give the carriage plenty of play. A piece of magnet or annunciator wire should lead from the left contact of this switch thru hole C, and be grounded to the support of the cylinder rod. The main terminal of the battery switch must be connected to the other binding post at the back of the base. Both machines must be connected the same way.

Now suppose we examine these circuits. First turn the battery switch to the contact at the left—the position used when "sending." The current now comes from the binding post to the switch, thru the right contact to the upright and thru the rod to the cylinder, thence thru the needle down one of the flexible wires to the other binding post. When the switch is thrown to the right or "receiving" position, the current passes to the carriage magnets.

Excepting for the gear connections, the machines themselves are now completed, but as no picture can be transmitted unless the cylinders run in *synchronism,* I shall presently explain three ways to synchronize them before showing how to prepare and transmit a picture.

(*Part II will appear in the October issue*)

Popular Astronomy

By Isabel M. Lewis

(*Continued from page* 400.)

his weight would be zero. Continuing from the center to the surface thru the same shaft the weight would increase progressively until the surface value of 150 lbs. was restored.

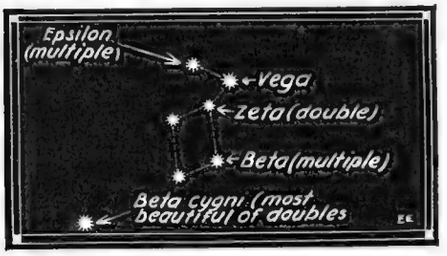
WEIGHT ABOVE SURFACE OF EARTH.

If, on the other hand, it were possible for a man to ascend above the earth's atmosphere he would still be subject to the attraction of the earth (see diagram IV), but the force would *decrease* inversely as the square of his distance from the earth's center, so at a distance of two radii, or 8,000 miles from the earth's center, a man weighing 150 lbs. at the surface would weigh only one-fourth as much as at the surface of the earth, or 37½ lbs. At a distance of six radii, or 24,000 miles, from the earth's center, he would weigh 4⅙ lbs., and at a distance of about 12¼ radii, or 50,000 miles, his weight would be only one pound. If the distance should be increased to four times this amount, or 200,000 miles, his weight would be decreased to one-sixteenth of his weight (at 50,000 miles)—or one ounce.

ASTRONOMICAL QUESTIONS AND ANSWERS.

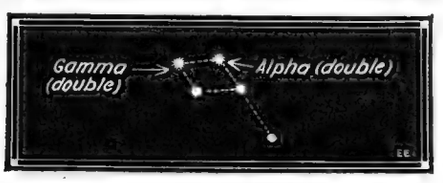
Question 1. What is the sidereal system and sidereal time?

Answer 1. (a) The terms sidereal system, stellar system, and sidereal universe, are all synonymous and refer to the organized system of the stars in which our solar system is a single unit. The stars do not move in a haphazard manner but are governed by some definite law and purpose



and organized into some great system. To this system belongs the Milky Way as well as practically all the stars, both visual and telescopic, the great irregular gaseous nebulae, the globular star clusters and loosely formed moving star clusters, such as the Hyades and Pleiades groups. It is not yet known whether the spiral nebulae are subordinate units in the sidereal system to which our sun and his satellites belong, or whether they are external systems or external universes independent of our own sidereal system and units along with it in some vaster system.

Answer 1. (b) Sidereal time is "star" time as distinguished from solar time or "sun" time. A sidereal day is the interval between two successive passages of the meridian across the same star. The sidereal time of any place on the earth is zero when the meridian of that place crosses the vernal equinox (point of intersection of the celestial equator and the ecliptic), which is chosen instead of a star as the point of reference for sidereal time. A "solar" day is the interval between two successive passages of the same meridian across the center



Why Not Earn $35.00 to $100 A Week As A Mechanical Draftsman?

"Get into the profession of big pay and Rapid Advancement with the help of the school that has started hundreds on the Road to Success. I am ready to help you." Roy C. Claflin, President, Columbia School of Drafting.

Learn At Home In Spare Time

You don't have to stop work or leave home in order to become a trained Draftsman. Through our practical home study Training we will teach you Right in Your Own Home so that you will soon be able to qualify for a good position at Big Pay. We will continue to instruct and help you until we know you have the knowledge necessary to succeed.

No Previous Training Necessary

Right now—TODAY—there are openings for thousands of Draftsmen in the Government Departments, industrial concerns, and the big engineering offices. One department alone recently called for 1,800 draftsmen. With this tremendous demand has come a big increase in salaries.

Draftsmen Are Getting $35 to $100 a Week

with big chances for even better pay as the demand grows. By enrolling NOW for our practical Home Study Course in Drafting you can quickly qualify for a position as Draftsman and by properly applying the principles we teach.

You Have a Chance to Become a Chief Draftsman

and get to the very top in this fascinating profession. Our course will give you just the knowledge you need to make good as chief draftsman when your chance comes.

Peace Calls For More Draftsmen

With the problems of reconstruction facing the nation the demand for draftsmen is even Greater Than During the War. All big engineering, construction and manufacturing projects must first go through the drafting room before the workmen can commence. You can help in the work of reconstruction and secure a Big Salary with excellent opportunities for advancement. Prepare now and be ready when the demand reaches its height.

We Will Help You Secure a Position

as soon as you complete our course. We have already placed hundreds of our graduates in good paying positions and are constantly in touch with vacancies for which Draftsmen are Urgently Needed. Government Departments and Private Concerns are continually calling upon us for our graduates because they know that our instruction produces draftsmen of the caliber they need.

Thousands of Men Wanted Right Now

Drawing Outfit FREE As soon as you enroll you will be sent our special drawing outfit FREE so that you will be sure to have it to work with while taking the course. This set will be yours to keep. You are not asked to return it after completing the course.

Illustrated Book of Particulars Sent Free

Fill in the coupon below—send it to us and we will send you FREE a copy of our illustrated book telling all about our practical Home Study Course and how you may secure our instruction at once on Easy Terms so as to quickly qualify for one of the Big Positions Now Open.

Mail This Coupon To-day

Columbia School of Drafting
Dept. 1053, 14th and T Sts., N. W.
Washington, D. C.

Without obligation to me, please send me your illustrated book telling how I can secure your complete Home Study Course, the FREE DRAWING OUTFIT, and your help in securing a position as Draftsman.

Name .....

Address .....

City .....State .....

DIAMONDS WATCHES ON CREDIT

SEND FOR FREE CATALOG

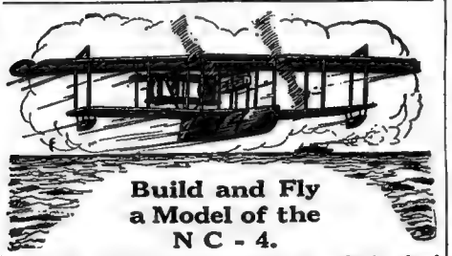
There are over 2000 illustrations of Diamonds, Watches, Jewelry, etc. Whatever you select will be sent, all shipping charges prepaid.
You see and examine the article right in your own hands.
If satisfied, pay one-fifth of purchase price and keep it; balance divided into eight equal amounts, payable monthly.
LIBERTY BONDS ACCEPTED

Watches
Our Catalog illustrates and describes all standard world-renowned Watches—solid gold and gold filled cases. Splendid bargains in 25-year guaranteed Watches on credit terms as low as
$2.50 a Month

Special Bargains
Diamond La Vallieres - - - - $10 up
Loftis 7-Diamond Solitaire Cluster Scarf Pins $75 up
Diamond-Set Birth Month Rings - - 8 up
Diamond Brooches - 7 up
Diamond Ear Screws 25 up
Diamond Studs - - 10 up
Diamond Cuff Links 5 up
Wrist Watches - - 20 up
Watches, Gold Filled 15 up

Diamond Rings
Beautiful Genuine Diamond Rings, any style 14-K solid gold mounting, wonderful values at $25, $50, $75, $100 and up.
EASY CREDIT TERMS

WE HAVE BEEN IN BUSINESS OVER 60 YEARS
LOFTIS BROS & CO. 1858
The National Credit Jewelers
Dept. D.22 108 N. State St.
CHICAGO, ILL.
STORES IN LEADING CITIES



Build and Fly a Model of the N C - 4.

This new "IDEAL" Model Aeroplane is a dandy—the celebrated Naval-Curtiss Seaplane, first to cross the Atlantic Ocean—a strictly American 'plane every American boy will want to build. 4½ feet across the planes and a true, scale-model duplicate of the real NC-4. Guaranteed to rise from the water and make a perfect flight under its own power. Get a set of "IDEAL" Accurate Scale Plans, including Building and Flying Instructions, and build this wonderful Model Aeroplane right away.

Plans and Instructions for Building a 4½ foot Model NC-4 50c

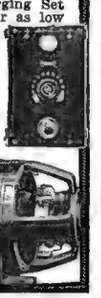
Other Plans and Instructions at following prices, all sent postpaid:

DE HAVILLAND BATTLE PLANE..35c
Curtiss Military Tractor 25c
Bleriot Monoplane 25c
Nieuport Monoplane 25c
Taube Monoplane 25c
Cecil Peole Racer 25c

"IDEAL" Model Aeroplane Construction Outfits, containing all parts and materials needed to build these Model Aeroplanes, are sold by Leading Toy, Sporting Goods and Department Stores.
Ask for them at your store.
"IDEAL" Model Aeroplane Catalog, 48 pages, 5c postpaid.
IDEAL AIRPLANE & SUPPLY COMPANY
Established in 1911
159-161 Wooster St., New York City

PROFITS for YOU { Charging Batteries Making Electric Lights

With the HB Lighting and Battery Charging Set you can make your own electric lights for as low as 2c per KW, and make a profit from $100 to $150 per month on battery charging. Anyone can easily operate without experience. Sturdy, dependable, economical to operate from line-shaft or your engine.
Small Payments Put This Money-Maker In Your Shop
Balance on easy terms. Profits pay for outfit. Absolute Money-Back Guarantee. Ask our Service Department about proper size for your needs. Pin this ad to your letterhead and write TODAY for information.

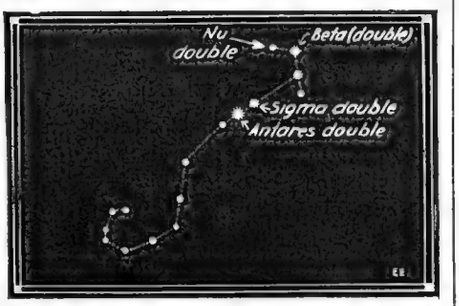


HOBART BROTHERS COMPANY
Box 92E, Troy, Ohio
Successful Manufacturers Since 1893

FREE BOOK ON AVIATION
Learn of the great opportunities in this new $1,000,000,000 industry. Thousands of men needed. Learn by mail—free book tells how. Write at once.
Nat. Aero Inst., Dept. 744Z, 916 S. Mich. Av., Chic.

of the sun. As the sun appears to move eastward among the stars about one degree a day the solar day is longer than the sidereal day by about four minutes, the time that is required for the meridian of the place to turn thru an angle of one degree and "overtake" the sun. Since the sidereal day is four minutes shorter than the solar day the stars appear to rise four minutes earlier and to come to the meridian four minutes earlier each successive evening.

Question 2. Please name and locate a few double and multiple stars.



Answer 2. An interesting multiple star is Epsilon Lyrae, now visible in the constellation Lyra about 2° N. E. of Vega (on the meridian 9 p. m. Aug. 30). The two wider components are 207 seconds of arc apart and can be distinguished as separate objects by persons with exceptionally fine eyesight. Each of these components is itself a double star and can be separated with a three-inch telescope. Beta Lyrae, about 6° S. E. of Vega, is not only an interesting multiple star but also a remarkable variable with a period of nearly thirteen days and a range of one magnitude.

There are several interesting doubles in addition in this constellation, which is a fine field for a three-inch telescope.

Beta Cygni, about fifteen degrees to the southeast at bottom of Northern Cross is a most beautiful double.

In the constellation Delphinus, known as Job's Coffin, are two fine doubles, Gamma and Alpha. This constellation is a small diamond-shaped group of stars about 30° to the southeast of Lyra.

In the constellation Scorpio (in southern skies in August west of meridian in the early evening) are three interesting doubles, Sigma, Beta and Nu. Sigma is the star just north of Antares, the brilliant red star in this constellation. Antares also has a greenish companion, but it takes a four-inch telescope to separate it. Nu and Beta are about ten degrees northwest of Antares.

200,000 Horse-power in One Hour

(*Continued from page* 409)

will go out of its way or take a round-about course. However, it notifies the system operator; subsequently these warnings either discoutinue, or the rapidity of the signals increases as the storm approaches or dies out. With this storm, however, it was different; it approached with hurricane velocity, and when about one-half to one hour away the bell strikes every minute.

This now became a positive signal that the storm was about to break, and that within a very short time. The fires in the boiler room, which have been banked up to the present time, are now let loose and coaled up. Within a short time "steam is up" in the boilers. The system operator now, by means of telephone or other forms of annunciators, directs the starting of the gigantic reserve generators, so that everything will be in readiness should the storm break. Now the auxiliaries are started. The system operator is warned by the bell ringing continuously, and the device, which

Adventures of the Auto-Wheel Coaster Club

The Circus Parade

Jim, the Club Captain, is a great one for new ideas. When the circus hit town last week, he said the Auto-Wheel Coaster Club "ought to march in that parade."
So we all took our Auto-Wheels down to the show-lot, and when the march started we joined in. We hitched on to the biggest elephant in the show and followed along. We didn't have to decorate those Auto-Wheels. They're good-looking to begin with. And they ran along just as smooth as autos. You should have heard the crowd cheer when we passed. "Biggest Hit in the Whole Parade," the folks said. And after it was over five fellows came up and wanted to know where they could get Auto-Wheels. Jim sent them to the local dealer, and they are going to join the Club. Jim has sent to The Buffalo Sled Co., for FREE Club Caps for them, like ours.

This is the famous Auto-Wheel Coaster
—and here is the patented Auto-Wheel Convertible Roadster
AS A ROADSTER
AS A COASTER

BOYS:—DO YOU WANT WAGONS LIKE THESE?
The Auto-Wheel Coaster is a wonder—smooth-running, strong, speedy. The Auto-Wheel Convertible Roadster is two wagons in one—can be changed from a Coaster to Roadster in a second.
Send us three dealers' names, telling which one handles the Auto-Wheel. We'll send you Free Felt Pennant and Booklet.

The Buffalo Sled Co.,
163 Schenck Street,
N. TONAWANDA, N. Y.
(In Canada: Preston, Ont.)

NORMA TALMADGE says:
"It is one of my favorite magazines. I enjoy reading it every month."

"JUST to get acquainted" send a dollar and receive the next four numbers of

The PHOTO-PLAY WORLD
Contributions by leading authors
Beautifully illustrated, handsomely printed
By the year $3.50—35 cents a copy
Trial Offer: 4 numbers for $1
(Foreign postage 50 cents extra)
THE DOWNS PUB. CO., Bulletin Bldg., Phila., Pa.

$5.00

Noiseless Target Practice
Fit your .22 with a Maxim Silencer and get no end of fun this summer practicing in your back yard and on your vacation.

MAXIM SILENCER MAKES YOU A BETTER MARKSMAN

It eliminates recoil and all noise of the report, and steadies your aim. Direct from Dealer or Factory $5.00. Write for Free Book of Stories.

MAXIM SILENCER CO.
89 Homestead Ave., Hartford, Conn.

has finished its overtime work, is now short-circuited. There is no further need of warning. The city becomes enveloped in darkness equal to that of night. Suddenly the storm breaks and together with a downpour of rain comes the click of so many light sockets and the pull of so many chains, and we think no more of it. The "juice" is there and we have light.

We never realize how those fellows up at Waterside station have to work in order to supply this demand. There is the crashing of many huge switches, as extra feeders are put into operation, and finally as a last resort powerful storage batteries are thrown into the circuit so as to supply the city with its increasing demand for electricity—and this has been done with no inconvenience and without bravado. Thanks to the Edison service, New Yorkers were able to work at their offices as late as desired, while the house and theater lights blazed forth by the hundred thousand.

Electric Cookery—A Snap!

By Grace T. Hadley

(*Continued from page* 412)

oven switches on *High* for fifteen minutes in advance. Bake paste fifteen or twenty minutes on *High* heat.

Quick Coffee Cake.—Turn oven switches to *High* before preparing cake. Sift together twice one pint of flour with one-third cup of sugar, three heaping teaspoons of baking powder, one-half teaspoon each of salt and cinnamon. Mix to a soft dough with one cup of milk stirred into a well-beaten egg. Add four tablespoons of melted butter and spread in a buttered shallow pan. Sprinkle over with granulated sugar mixed with cinnamon. Bake on lower grate from twenty to twenty-five minutes, turning switches to *Medium* for last ten minutes of baking.

Date Muffins.—Cream three tablespoons of butter with three of sugar and add two well-beaten yolks of eggs, then three-fourths of a cup of milk and two cups of pastry flour sifted with three scant teaspoons of baking powder. Beat well and add the stiffly beaten whites of the eggs and a cup of dates cut into small pieces. Turn oven switches to *High* twenty minutes in advance and muffins should bake in from twelve to fifteen minutes with switches left on *High*.

Advantages of Electric Ranges.

The modern electric range is really a triumph in beauty of design and workmanship. Clear white enamel walls and oven door panel, bright nickel trimmings make this type of range a source of pride and joy to the particular housewife. There is so much labor saved. There are no black bottomed pans and pots to be washed, hence there is a great saving in the matter of cleaning up after the cookery process. The easy control and perfect regulation of the heat establishes dependable temperature conditions. Best of all is the satisfaction of doing good cookery in the most modern way.

"I would not be without my electric range for anything," is the verdict of Mrs. Modern Housewife.

A Dinner Prepared in Automatic Electric Range.

Chicken, 3 lb.; pudding, 1 quart; baked potatoes, six. Place in upper oven; current on thirty-five minutes. Wattage should be 875.

Scenes from the Universal Film "Heads Win!"

"Heads Win!"

Traffic jammed at the rush hour! Crowds thronging station platforms! A mile of stalled trains! The swing-bridge would not close and all because down in the power house something had gone wrong and nobody knew what—until Jim came to the rescue.

Each night thousands are seeing unfolded on the screen the thrilling story of Jim Godfrey, who, in the hours after supper, with the help of the International Correspondence Schools, had put a trained head on his shoulders—a head that knew what to do in an emergency.

There are thousands of Jims in real life. You will find them in offices, shops, stores, factories, in mines and on railroads. For in every city and town and in every line of industry there are men who have gained in spare moments, with I. C. S. help, special training in the work of their choice.

There are men like Jesse G. Vincent, who rose from a toolmaker's apprentice to Inventor of the Liberty Motor; men like Joseph G. Tynan, the laborer who became the world's greatest ship builder; men like Robert E. Ramsay, the clerk who became editor of Advertising and Selling. There are carpenters' helpers who became architects, bookkeepers who became general managers, men and boys who rose from nothing at all to responsible positions at splendid salaries.

It's simply a question of training. Your hands can't earn the money you need, but your head *can* if you'll give it the chance. "Heads win" every time!

More than two million men and women in the last 28 years have let the I. C. S. help them win better jobs, make more money, enjoy happier homes. Over one hundred thousand right now are turning their spare moments to profit. Hundreds are starting every day.

Can you still go on, putting in your days at the same grind, getting the same pay envelope with the same insufficient sum, keeping up the constant fight against a soaring cost of living, when a little grit on your part could be the means of changing your whole life?

It is easily possible for you to have the position you want in the work you like best, to have a salary that will give you and your family the kind of a home, the comforts, the little luxuries, the enjoyments that you would like them to have. No matter what your age, your occupation, your education or your means—you can do it!

All we ask is the chance to prove it. That's fair, isn't it? Then mark and mail this coupon. There's no obligation, and not a penny of cost. But it may be the most important step you ever took in your life. Take it *now!*

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6198, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ SALESMANSHIP
☐ Electric Lighting and Rys.	☐ ADVERTISING
☐ Electric Wiring	☐ Window Trimmer
☐ Telegraph Engineer	☐ Show Card Writer
☐ Telephone Work	☐ Sign Painter
☐ MECHANICAL ENGINEER	☐ Railroad Trainman
☐ Mechanical Draftsman	☐ ILLUSTRATING
☐ Machine Shop Practice	☐ Cartooning
☐ Toolmaker	☐ BOOKKEEPER
☐ Gas Engine Operating	☐ Stenographer and Typist
☐ CIVIL ENGINEER	☐ Cert. Pub. Accountant
☐ Surveying and Mapping	☐ TRAFFIC MANAGER
☐ MINE FOREMAN or ENG'R	☐ Railway Accountant
☐ STATIONARY ENGINEER	☐ Commercial Law
☐ Marine Engineer	☐ GOOD ENGLISH
☐ Ship Draftsman	☐ Teacher
☐ ARCHITECT	☐ Common School Subjects
☐ Contractor and Builder	☐ Mathematics
☐ Architectural Draftsman	☐ CIVIL SERVICE
☐ Concrete Builder	☐ Railway Mail Clerk
☐ Structural Engineer	☐ AUTOMOBILE OPERATING
☐ PLUMBING AND HEATING	☐ Auto Repairing
☐ Sheet Metal Worker	☐ Navigation ☐ Spanish
☐ Textile Overseer or Supt.	☐ AGRICULTURE ☐ French
☐ CHEMIST	☐ Poultry Raising ☐ Italian

Name_____

Present Occupation_____

Street and No._____

City_____ State_____

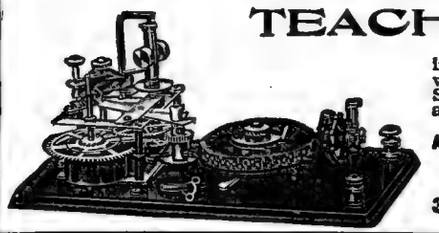
Canadians may send this coupon to International Correspondence Schools, Montreal, Canada

"THERE'S MONEY IN IT"

AT HOME **LEARN TELEGRAPHY** AT HOME

MORSE AND WIRELESS

TEACH YOURSELF



In half the usual time, at trifling cost, with the wonderful Automatic Transmitter, **THE OMNIGRAPH.** Sends unlimited Morse or Continental messages, at any speed, just as an expert operator would.

Adopted by U. S. Gov't. 4 styles. Catalogue free.

OMNIGRAPH MFG. CO.

39L Cortlandt St. New York

ELECTRICAL ENGINEERING IN ONE YEAR

training again open to civilians. Over 3000 men trained for electrical industries in experience of more than a quarter of a century. For men of ambition and limited time. Condensed course in Electrical enables graduates to secure good positions and promotions. Theoretical and Practical Electricity, Mathematics, Steam and Gas Engines, Mechanical Drawing. Students construct dynamos, install wiring and test electrical machinery. Course with diploma, complete.

Thoroughly equipped fireproof dormitories, dining hall, laboratories, shops. Write for catalog. 27th year opens October 1, 1919.

BLISS ELECTRICAL SCHOOL
260 TAKOMA AVENUE, WASHINGTON, D. C.

Says the Master Mechanic. The Greb Automatic Grip Puller is a One-Man Puller—Quick-acting, strong and simple in the extreme. May be locked in any desired position. A combination of two or three arms. Heavy Duty Size capacity 1" to 18"—Junior size capacity 1" to 7". Two sets of jaws furnished with each size.

Ten Days' Trial If your dealer or jobber does not have them we will send you one. Try it ten days. If not satisfactory, return to us and we will refund your money. We also make the GREB RIM TOOL.
THE GREB CO., 230 State Street, BOSTON

Learn Autos and Tractors

Wonderful opportunities constantly offered trained men; we train you thoroughly to start your own business or make good money as motor expert, driver, shop foreman, etc.

5000 Graduates making good. Catalog Free.

Cleveland Automobile School, 1807 E. 24th St., Cleveland, O.

Price 50c up

On market 5 years. Over 10,000,000 in use. Every set guaranteed. Popular thru service. Don't rebore cylinders. "NO-LEAK-O" makes good when others fail. Made different. Give results no other ring can. Write for booklet. Order from nearest Jobber, or write direct.
NO-LEAK-O PISTON RING CO., Baltimore, Md.
Beware of Imitations. See that NO-LEAK-O is on EVERY PACKAGE.

The Seneca MOTOR CAR **Built for the Owner** **$1085.00**

Simple, Sturdy construction. Low cost of up-keep and operation. Cantilever springs in rear. Comfortable E-Z riding. 4 cyl. - 27 H. P. 108 in. wheel base.

Dealers Wanted Immediate deliveries. Fifth successful year. Increased output. Liberal newspaper advertising in dealers' territory. Wonderful opportunities. Write or Wire NOW.
THE SENECA MOTORCAR CO., 49 Seneca Factory, FOSTORIA, OHIO

DENINGER WILL SAVE YOU $40

BIG MONEY SAVINGS FOR YOU

Used and rebuilt motorcycles, single and twins, $25 to $100. Used bicycles, $5.00; tandems, $10. All machines guaranteed in good working order. New bicycles and motorcycles at Factory prices. You save dealers' profits. Motorcycle and automobile tires too, $3.00. Complete line of parts and supplies.

Send for catalog

Deninger Cycle Co., Rochester, N.Y.

YOU 25 TO 50 DOLLARS

FREE! Sonora

These phonograph needles replace steel needles, play 50 to 100 times and are used on ALL MAKES of steel needle records. Economical, convenient, improve tone, and preserve records. 30c per card of 5, 40c in Canada. Write today for FREE sample.

Semi-Permanent Silvered **NEEDLES**

Sonora Phonograph Sales Company, Inc.
GEORGE E. BRIGHTSON, President
279 Broadway, Dept. G, New York Toronto: Ryrie Bldg.

BUILD A $100 PHONOGRAPH

Assemble your own Phonograph

Do it yourself easily. Have the finest machine. Astounding saving. We give you the phonograph secrets. Complete instructions 10 cents.

ELECTRO MECHANICAL PARTS CO.
160 N. Wells St. CHICAGO

Want to Make Money? Send for our big July and August Sale By Mail. You'll save many dollars on your summer purchases of Cameras, Jewelry, Auto Supplies and Traveling Goods.
DAVID STERN COMPANY
1027K Madison St., CHICAGO, U. S. A.

STAMPS

50 diff. Belgium (large bi-color), China, Jamaica, Portugal, Venezuela, etc., 10c; 100 diff., nice packet, 20c; 1,000 well mixed, 40c; 100 var. U. S., 50c; 1,000 hinges, 10c; Agts. wanted, 50%. List free. I buy stamps. L. B. Dover, Overland, Mo.

Carrots, spinach, turnips, in three-cluster utensil. Current on fifteen minutes. Wattage 213.

Food cooks in both ovens one and a half hours.

Make coffee in electric percolator, four cups; 167 watts.

Princess Pudding.—Two-third cup butter, one cup sugar, one large cup flour, three eggs, one-half teaspoon baking powder, small glass cider. Rub to smooth cream butter and sugar, add eggs one at a time, beating few minutes after each addition; add flour sifted with baking powder and cider; put into mold well buttered, set in sauce pan in some boiling water; steam thus one and a half hours; turn out on dish carefully; serve with lemon sauce.

Tapioca and Cocoanut Pudding.—One cup tapioca soaked overnight, one quart milk, yolks four eggs, whites of two, one cup sugar, two tablespoons grated cocoanut; bake one-half hour. Make frosting of whites of two eggs, three tablespoons sugar, two tablespoons grated cocoanut; spread over pudding when baked. Set in oven until light brown.

DINNER
Asparagus Soup
Pseudo Roast Chicken
Carrots Espagnole
Baked Tomatoes or Potatoes
Salad
Fruit Tarts Whipt Cream
Demitasse

Pseudo Roast Chicken.—To avoid cold storage chicken and yet have it tender, try the "pseudo roast." Take the cleaned fowl, place it in kettle of water already heated to boiling. Simmer gently in boiler oven, current low, until chicken meat becomes tender; twenty minutes before mealtime baste chicken with butter and place in oven, current on *High* until golden brown.

Carrots Espagnole.—Boil and mash thru a colander two or three bunches of carrots; beat into them melted butter, pepper, salt and cayenne or paprika; add two eggs well beaten and grated cheese to taste; bake in mold and serve turned out on a hot dish; garnish with parsley. It should be as light as a souffle. Cook carrots in boiler oven. Bake tarts, tomatoes or potatoes, chicken and carrots espagnole in large oven.

Electric luncheon to Northwestern Electric Equipment Co. by Edison Electric Appliance Co., Hotpoint Division, January 10, 1919. Menu for forty-five guests:

Celery Olives
Chicken Soup Wafers
Roast Beef, Meat Sauce
Potatoes and Peas in Cream
Sweet Corn in Ramekins
Raisin Bread Sweet Rolls
Head Lettuce Salad
Plum Pudding, Hard Sauce
Coffee Cheese Straws
Van Dyke Cigars

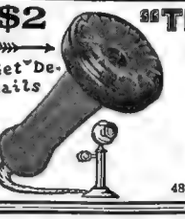
Prepared on electric range by Miss Bell, of the Minn. Gen. Elec. Co.

10 cans soup	469	watts
18 lbs. roast beef	2,325	"
1½ pks. potatoes	1,188	"
2 cans peas, 5 cans corn	300	"
6 loaves bread	1,000	"
5 doz. rolls	700	"
50 portions pudding	1,275	"
70 cups coffee	525	"

At 4 cents per kilowatt-hour, this generous repast was prepared entirely at a cost of 31 cents per person. The operation was in charge of Miss Bell, of the Minn. Gen. Elec. Co., with one assistant, and not only were they on the job only ninety minutes, but the task found them just as sweet and clean as tho they had never seen a kitchen.

Total wattage was 7,782, or 172.9 per person. How was it done? By utilization of one great essential in successful range operation—stored oven heat. Of four surface burners only three were used to a current consumption of 2,682 watts.

$2 Get Details



"THERAPHONE"
REFINED PHONE SERVICE

High power Scientific Receiver Earpiece is tuned to the ear. It can't confuse nor fatigue. Absorbs shocks, improves the Hearing and conserves time. For Busy, Deaf, Nervous, Privacy and Noises. Guaranteed to suit. (Check or C. O. D.—Export $2.20). No Agents.

Evolution Phone Company
48 Greenwich Ave., New York City

SECURE A MOTOR-CYCLE AT LOW COST

by putting a RELIABLE STEFFEY MOTOR on your wheel. Easy to attach. Costs less to run than an expensive motorcycle. Write at once and secure low factory prices.

STEFFEY MFG. CO.
Dept. E, 5025 Brown St., Philadelphia, Pa.

SAVE ½ ON AERIAL WIRE

Special sale of No. 12 or No. 14 Copper Wire at the remarkably low price of
30c per 100 foot roll
50c per 200 foot roll
Add 7c for postage charges.
Send 5c for our big illustrated catalogue showing scores of other bargains for electrical experimenters.

ELECTRICAL SPECIALTY COMPANY
Dept. E—48 So. Front St., Columbus, O.
Dept. E—128 So. 11th St., Phila., Pa.

MARKO
STORAGE BATTERIES
ARE GOOD—TRY ONE
Paul M. Marko & Co., Inc.
1402-1412 Atlantic Ave.
Brooklyn, N. Y.

158 Genuine Foreign Stamps—Mexican War Issues, Venezuela, Salvador and India Service, Guatemala, China, etc., only **10c.** 00 all diff., fine, 15c; 200 all diff., 25c. FINEST APPROVAL SHEETS 60% to 80%. AGENTS WANTED. Big 72-page Lists FREE! We Buy Stamps. Est. 25 years. **C. E. HUSSMAN STAMP CO. Dept. 67 ST. LOUIS, MO.**

BE A C.P.A. ACCOUNTANCY
The Highest Paid Profession taught thoroughly in a few months of home study by new system.
FREE BOOK International Accountants Society
Dept. 39J, 2628 S. Mich. Ave. Chicago

Learn Watchwork, Jewelrywork and Engraving A fine trade commanding a good salary, and your services are always in demand. Address HOROLOGICAL Department, Bradley Institute, Peoria, Ill., for our latest catalog.

TYPEWRITERS

$10 AND UP. ALL MAKES. SAVE $25 TO $50 on rebuilt at the factory by the well-known "Young Process." Sold for low cash—installment or rented. Rental applies on purchase price. Write for full details and guarantee. Free trial. **YOUNG TYPEWRITER CO., Dept. 822, Chicago**

$200,000 RADIUM INSTITUTE TO TREAT CANCER.

The establishing of a splendid Radium Institute for Cancer Treatment is being built at Los Angeles, Calif., by King C. Gillette, of safety razor fame. The institute is being established for the study and treatment of neoplastic (tumor and cancer growth) diseases. It will be the only one of its kind in the West, and will employ upwards of $150,000 worth of radium. Mr. Gillette is to be president of the institution, and Dr. Rex Duncan will act as medical director.

In his announcement recently Dr. Duncan, who has just returned from the East, where he studied the use of radium at Johns Hopkins, Harvard and Cornell cancer research institutes, stated that the Los Angeles institute will use more radium and radium therapathic equipment than can be found in all the other territory west of the Atlantic Coast. The building "L" will cover an area 65x38 and 50x36 feet. In addition to its offices and elaborately-equipt laboratories, it will have a large number of beds for patients who find it necessary to remain at the institute for a time.

"The purpose of this institution," said Dr. Duncan, "is to provide unexcelled facilities for radium therapy, and the study and treatment of neoplastic disease. The benefits to be derived will be available to all requiring such treatment, and a fee consistent with the financial condition of the patient will be charged. Any profits earned above those required for the proper maintenance and equipment of the institution will be devoted to scientific and research work."

WORLD'S BIGGEST TURBINE DYNAMO—100,000 H. P.

(*Continued from page* 401)

chine is combined with the flexibility and reliability of three regular independent units.

The entire control of this turbine, together with all the others in the power house, is centered at an electric switchboard located in a room in the upper part of the power house. Here, by merely operating a few dozen small keys, resembling telegraph keys, the operator starts and stops the turbines in accordance with the demands of the transportation system, directs the current into various circuits as required, makes special connections to meet emergencies, and in other ways keeps New York constantly on the move. The responsibilities connected with this work can hardly be over-estimated, since a single error might tie up half of the city's elevated, subway, and surface lines.

In addition to this human control, a system of governors has been devised for the large turbine that automatically takes care of almost every possible contingency. In consequence, the machine practically runs itself and one of the things that strikes a visitor is the fact that workmen are rarely seen on the power house floor.

For the technical reader the following details will be of interest. Superheated steam enters the *high pressure* element at 205 lbs. pressure and dividing into two portions is exhausted into the *low pressure* elements at 15 lbs. pressure. From the low pressure elements it goes into the *condensers* in which a 29-inch vacuum is maintained; 826,000 lbs. of steam are used per hour for the maximum load, and the water rate is below 11 pounds of steam per kilowatt-hour. The generators are each rated at 20,000 KW continuously and 23,500 KW for two hours. Three-phase, 25-cycle current at 11,000 volts is delivered to the substations. The floor space occupied by the entire turbine is only 52x50 feet and its height is about 20 feet.

Photos Courtesy Westinghouse Elec. & Mfg. Co.

Oh! you Misfit!

LIONEL STRONGFORT

"Dr. Sargent, of Harvard, declared that Strongfort is unquestionably the finest specimen of physical development ever seen."

SAILING under the name of man. You know the truth if no one else does—you know what you lack—what you need. You may hide it from others in a way, but you can't hide it from yourself. Are you a victim of any pernicious habit that you want to get rid of? Have you a spark of ambition left to be the man you once were, to be the man you ought to be? Are you an easy victim of every little ailment that comes along, going around without snap or ginger, losing ground when you ought to gain it? Then wake up and be a man, not a misfit. Deserve the name of man; be vigorous, virile. It makes no difference if you are a physical wreck, if you join hands with me, I'll make you the kind of man that's wanted, the kind of man needed, the kind of man looked for, sought for, bid for all the time, and it will be done without drugs, or tonics or stimulants.

You will gain in vim, and vigor; your muscular power will increase in flexibility and strength, your nervous system fortified to renew its energy, not bolstered up for the time being, to fall back below the level it was, as it does when you resort to drugs or medicine.

You married men come across to yourself—get the pep and ginger and tingle of life into you. You are not living for yourself alone; you need dash, spirit, the enterprise you used to have. Regain and maintain your vigor; I'll show you how.

You business men—overworked, did you say? You are not doing half as much as you ought with your experience. Never mind, there is a way to get back your aggressiveness, to be right in the fight and enjoy it. You can double your percentage of real worth as a man, and enjoy life as you ought to be able to do.

You young man—think of your future—how about it—are you fit for marriage—are you qualified—do you feel it in your soul—are others sliding by you doing more—getting more than you are? I know what is dragging you down, what is keeping you down, and it is time, high time, that you **Stop.** No one can abuse nature and succeed; others tried it and failed miserably. Do you want to be a failure, or even worse than a failure? Then come to me; I have helped thousands; physically, mentally, morally. I will help you; I will make you the kind of young man that is a credit to any community— will make you so that your progress in any undertaking will be easier. Just be frank and above board—tell me your troubles. I will guide, direct and point the way; the natural way for you to achieve what I have said—Nature's way. You can stop the drain on your system, you can be free from bad habit, gain muscular tissue, be strong, virile, erect in carriage, courageous and likeable to all you meet. Let me be your guide, your teacher. I have pupils all over the world, learning a system of Health, Strength, moral courage building, known as

Strongfortism

Under my methodical system and the plan of practicing Strongfortism, you men can build your body up in symmetrical proportions as nature intended you to be. You will gain greater confidence in yourself, and compel others to have more confidence in you—it, best of all, brings you success—that you can call success, capped with the glow of health and the supreme joy of living. You can keep your youth with you, no matter what mistakes you have made, or what your present physical condition is, or what ailment or disorder you have—youthful errors, vital losses, devitalizing habits, poor memory, constipation, rheumatism, no matter what your present physical condition is. See that coupon, check what interests you, mail and I will send you helpful personal information. It will not cost you anything and it will surely help you to broader, bigger, better things and a great deal more happiness.

To know what Strongfortism can do for you, send for a copy of my book, "PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY." IT IS FREE—Just enclose three 2c stamps to cover mailing expenses to get a copy. SEND AT ONCE.

LIONEL STRONGFORT

Physical and Health Specialist

1033 Strongfort Institute NEWARK, N. J.

FREE CONSULTATION COUPON

Mr. Lionel Strongfort, Newark, N. J.—Please send me your book, **"PROMOTION AND CONSERVATION OF HEALTH, STRENGTH AND MENTAL ENERGY,"** for postage of which I enclose three 2-cent stamps. I have marked (X) before the subject in which I am interested. (1033)

..Colds	..Insomnia	..Youthful Errors
..Catarrh	..Short Wind	..Impotency
..Asthma	..Flat Feet	..Gastritis
..Obesity	..Stomach Disorders	..Heartweakness
..Headache	..Constipation	..Poor Circulation
..Thinners	..Biliousness	..Skin Disorders
..Rupture	..Torpid Liver	..Despondency
..Lumbago	..Indigestion	..Round Shoulders
..Neuritis	..Nervousness	..Lung Troubles
..Neuralgia	..Poor Memory	..Increased Height
..Flat Chest	..Rheumatism	..Stoop Shoulders
..Deformity (describe)	..Vital Losses	..Muscular Development

Name.....

Age.....Occupation.....

Street.....

City.....State.....

FLIES 500 FEET

Lightning Racer Experimental Model. This is not a toy. It is a practical, scientific flying model, guaranteed to fly hundreds of feet; designed and built from the finest selected materials, by Model Experts. This machine and our famous "Montauk Flyer" are the only Complete Model Aeroplanes guaranteed to fly 500 ft. selling for less than $5.00. This model, shipped with monoplanes detached, ready and guaranteed to fly, $3.75 prepaid. Send stamps for circular describing this wonderful model.
Blueprints of the following models 1-2 actual size 50 cents postpaid in U. S.
Bleriot Racer, flies 600 ft. Manhattan Racer, flies 2000 ft. Montauk Flyer, flies 500 ft. 3 ft. Curtiss or De Havilland Biplane, 75 cents each, postpaid.
HEC Flying Boat guaranteed to rise from the water and fly 500 ft. Two sheets blueprint $1.00 postpaid U. S.
HEC AEROPLANE CO., 300 E. 49th St., N. Y. C.

Send Only 12c

(Stamps Coin)

And I will send you a copy of my valuable booklet.

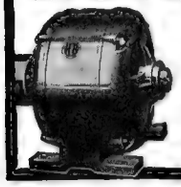
"Hints to Music Loving Owners of Talking Machines"

Tells you how to take care of your machine and records, preserve the life of both, and gives many pointers to improve the tone of your instrument and increase your enjoyment of it. Instructs on the care of the motor, cleaning, speed adjusment, care of the needles—in fact every thing you should know. Send 12c today and the booklet will come by return mail.

J. H. ELLIS, Box 882, Milwaukee, Wis.
Patentee & Manufacturer, Ellis Harmonious Reproducer

USE HB BALL BEARING ELECTRIC MOTORS

SAVE ON POWER BILLS—GET BETTER POWER.
HB Ball-Bearing Motors supply better power than gas engine or steam engine, and cost less to operate. Amply designed for hard service, trouble proof, absolutely reliable. Ideal for factory, garage or machine shop. Best service at lowest cost.
$20 Brings You Any HB Motor. Balance on Easy Terms. Sizes ¼ to 15 h.p. Choose to Suit Your Needs.



In planning your installation, write our service department. Get their advice—FREE. Simply state what machinery will be run and type of current available. Let us plan your power system for best results at least cost. Fill in this ad to your letterhead and mail TODAY for full information. Ask also about HB Battery Chargers, Generators, etc.
HOBART BROTHERS COMPANY
Box 93E Troy, Ohio
Successful Manufacturers Since 1893

FACTORY-TO-RIDER SAVES YOU MONEY

Buy direct and save $10 to $20 on a bicycle. **RANGER BICYCLES** now come in 44 styles, colors and sizes. Greatly improved; prices reduced. Other reliable models $16.75 up. **WE DELIVER FREE** to you *on approval* and *30 days trial* and riding test.
Our **big FREE catalog** shows everything new in bicycles and sundries. Write for it.
TIRES, lamps, wheels, parts and supplies at *half usual prices.*
Do not buy a bicycle, tires, or sundries until you get our *wonderful new offers,* low prices and liberal terms. A postal brings everything.
Ranger Electric Lighted Motorbike
MEAD CYCLE COMPANY Dept. G107 Chicago

35 Miles per hour Is Record of this Car

Boys, Build This Car. This nifty little car driven by gasoline motor, can be built by any boy. Parts are furnished by us and are very cheap. Send 26c for building plans and price list of parts showing how to build this lad's car.
STPHER MFG. CO.
156 Warren Street
TOLEDO, OHIO.

HERE BOYS

ALL THE PARTS & PLANS
50 CENTS PREPAID.
Don't Send Stamps
Made in a JIFFY, flies around your yard, Maiden very NIFTY, a toy you wont discard.
NIFTY NOVELTY & TOY CO., Newark, N. J.

Under-Water Surveying by Reflected Sound Waves

By H. Winfield Secor

(*Continued from page* 405)

to the greater sound conducting properties here presented, the velocity of sound wave propagation thru water being about 4,700 feet per second, or somewhat over four times the velocity of sound traveling thru air. Otherwise the sound waves in water behave much the same as they do in air, giving all the echo, reflection and diffraction effects and other well-known phenomena with which we are all familiar.

AUDIBLE AND INAUDIBLE SOUND WAVES.

Mr. Ries has spent a great deal of time on research in the physics of sound wave propagation and reception, and one of his startling statements was the fact that in time of war or for certain other reasons (where multiplex or selective communication might be required in a constricted body of water), it then becomes possible to apply his sound surveying and detecting system by means of *inaudible* sound waves, i.e., sound waves pitched either above or below the normal register of the human ear. The human ear normally does not detect the presence of sound waves at below eight vibrations per second nor higher than sixteen to seventeen thousand per second, altho among radio operators it is common to "hear" at a higher limit of audibility—30,000 vibrations per second. The buzz of the beetle's wings is in the neighborhood of 16,000 to 17,000 vibrations per second, and this is about as high a sound as the average ear will note, unless specially trained. This particular detail is unusually interesting to us, for if audible sound waves have to be relied on to detect an enemy submarine for instance in war time, then the enemy might hear the sound waves.

By means of specially sensitive apparatus well known to engineers and physicists, it is possible by several distinct means to thus utilize for the purpose of solving the location of a distant object under water, by sound wave triangulation *sounds above the audibility of the ordinary ear.* Mr. Ries has devised apparatus which will not only detect such sound waves at two points on the base of a triangle, but also record them.

As Mr. Ries pointed out, it is a simple yet not commonly known fact of everyday physics that a sound that is inaudible to one person may be audible to another person, all depending upon the structure of the outer ear and the thinness and elasticity of the diafram in every case. It has been proven by scientists that there are a perfect multitude of sounds surrounding us all the time of which we have no cognizance, simply because our ears do not ordinarily respond to these abnormal frequency sounds. For example, there are certain insects which make sounds inaudible to ordinary persons, and thus it is believed that they carry on communication between one another. Furthermore, simply because we do not hear a sound, such as produced by Mr. Ries's 20,000 to 30,000 cycle surveyors, while listening at the receiver connected to a submerged microphone, is not a reason why our ears would not under proper conditions pick up and interpret that sound to the brain. If the form of the outer ear, i.e., the shell of the ear, were properly formed with regard to its length and angle, quite possibly the diaframs of our ears would respond. Therefore, it becomes apparent that to hear a certain sound is certainly a case of ultra-mechanics, or building a sufficiently sensitive apparatus to hear a certain sound or range of sounds.

(*Continued on page* 457)

The Electric Safety razor makes shaving a pleasure. Blade vibrating 7,200 times a minute cuts the beard smoothly and without slightest pull or irritation—feels like a gentle massage. Can be used with or without electric current.

All users of the Lek-Tro-Shav speak well of it

A barber says—"Have shaved for years and have never used any shaving device near its equal."
A home user says—"The most pleasing shave I've ever had in my life. Shaves my face closer than I used to shave, but there is no after irritation or ill effects as I usually get from another razor."
No. 1 Made for use from Light Socket.
No. 2 Made for use from Dry Battery.
Write for illustrated circular describing Lek-Tro-Shav Safety Razor fully.
VIBRATING ELECTRIC RAZOR CO.
Dept. 122. Omaha, Nebr.

INSTRUCTION ON THE ELECTRICAL SLIDE RULE

On account of a number of men who have applied for instruction on the use and application of the *electrical slide rule,* we have selected the best rule for the purpose and prepared lessons which enables one to thoroughly understand how to handle it. We furnish a high grade rule in a leather case with the course of instruction. *The charge is small.* If interested write us.

BURGESS ELECTRICAL SCHOOL
745 E. 42nd Street, Chicago, Illinois

***Send To-day for the* "Electrical Worker's Friend"**

An electrical book of 66 motor drawings with complete instructions for rewinding and reconnecting A.C. motors. **Special at $3.50**
Or write for full particulars of this valuable book.
SMITH & SMITH PUBLISHING CO.
1524 LOWRIE ST., N.S., PITTSBURGH, PA.

Telegraph Pictures
BY ELECTRICITY

Complete sets of two machines of this marvelous equipment at ridiculously low prices. Instructive, mystifying and useful. This picture of President Wilson was telegraphed by these machines. Will transmit pictures, maps, drawings and hand writing. Picture telegraphing is the coming science. Write today.
J. LEISHMAN CO., Dept. T Ogden, Utah

Electricians Get up-to-date in HOUSE WIRING! Save TIME, MONEY, LABOR and MATERIAL by using our 98 GENUINE BLUE PRINT DRAWINGS, containing all the latest diagrams and connections known in house wiring—every diagram and connection up-to-the-minute as used by first class electricians for wiring BELLS, BURGLAR ALARMS, LIGHTS, ANNUNCIATORS, FIRE ALARMS and ELECTRIC GAS LIGHTING. These drawings are bound in the form of a flexible book (9 x 12) for convenience in using on the job. Send for them, and if they don't make you more efficient as a wireman and save you many times their cost as a contractor, return them and money will be refunded—you can't afford to be without them. ONE DOLLAR postpaid. Send for circulars on other sets of drawings.
PATENT SPECIALTY COMPANY
P. O. Box No. 583 San Francisco, Cal.

EXPERIMENTS

In—Science, Electricity and Invention
256 Pp., by P. Edelman, $1.50 Ppd.
Here is the big illustrated
how to make and do it book you want. Full of stunts, home laboratory wonders, models, etc.
Edelman Publishers, 1802 Hague Ave., St. Paul, Minn.

STAMMERER

Send 10 cents for my remarkable book, "How To Stop Stammering." Kill the fear of stammering. Re education the key.
The Hatfield Institute, 109 N. Dearborn St., Chicago, Ill.

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries address to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. . Only one side of sheet should be written on.

Developing an Idea*

By Nelson Hall

NEARLY every one at some time gets an idea that he would like to develop if he knew it was worth while. That is if the field is not already covered or paralleled. It is always a burning question with inventors to know what has or is being done along the line of his idea. In these days when improvements are being made so fast that the patent office issues over a hundred patents a day, it is not uncommon to find, much to the inventor's distress, that some one has covered his cherished idea with a patent or come near enough to be an interference. Realizing the time and money spent in developing, the litigation involved in interference or overlapping of claims, and the disappointment that comes from an invention which has little or no market value, the following information is being offered to those who are developing ideas.

When an idea occurs give it some time and attention. Lay it out in the mind as much as possible, make rough sketches until a clear mental picture is formed. Building models or samples is always very instructive and aids much in producing a working article. At any rate think it out so it can be drawn or some one can be directed to draw it or build it if it is a construction, or go thru the sequence of operations if it is compounding or manipulating drugs or chemicals.

When the conception is developed sufficiently that it can be seen thru all the operations and the parts are in fair proportions, make a complete assembly drawing showing very clearly the new parts, improvements and the novelty. Also write a brief concise but lucid description to accompany the drawing, and take these before a notary public and have one or more of your friends who understand the drawing and description sufficiently to identify them sign as witnesses. If a model has been made photographs of it should accompany the drawing and description. This is much stronger evidence, because it shows that work has actually been done in developing. By these papers and the date affixed by the notary public a record is made that will be taken in court should it ever be needed. Very often the date of conception is of the utmost importance in establishing the priority of claims.

Do not conclude that such documents make it unnecessary to take out a patent, for such is not the case. Should any one secure a patent on the same idea, tho your conception antedated his, it would cost a lawsuit to establish your claims. If too much time had elapsed from the time of the witnessing *the court would consider yours an abandoned idea* unless you could produce evidence of your developing. One should not delay taking out a patent. He should file his application as soon as he knows the idea will work, can be manufactured and marketed. But before one decides how well his idea will work, how suitable it will be for manufacturing and how well the buying public will receive it, some very careful thinking technically and painstaking sounding among manufacturers, prospective users, and salesmen are required.

Every one meets people in several walks of life during each twenty-four hours of the day, and some of these may have just the information desired. By a little artful juggling of words the conversation can usually be shifted to the desired topic and run something like this if, let us say, a tire iron is the idea under consideration:

"I just saw (in mind or the mental picture which was worked out in getting the idea into a working form) a man repairing a tire with a very unique tool. The way he rolled that four and a quarter over the rim beat anything I ever saw, and when it came to replacing it was just as easy."

"What kind of tool was it? I have seen several and have a very good one with my car."

"It was about eighteen inches long with a peculiar shaped hook at one end that slipt under the tire and hooked on the rim, giving an unusual amount of leverage. I understand that it is new and is going to be put on the market soon."

By carrying the conversation further an opinion can be formed whether or not this man who is a user of a car and a prospec-

* Owing to the fact that this special article by Mr. Hall is running this month, the usual "Patent Advice" Questions and Answers will appear next month.

U.S. PATENTS

Don't Lose Your Rights

Before disclosing your invention to anyone send for blank form "Evidence of Conception" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish your rights before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the U. S. and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception" sample, instructions relating to obtaining of patent and schedule of fees sent upon request. Ask for them,—a post card will do.

LANCASTER & ALLWINE

255 OURAY BLDG.,
WASHINGTON, D. C.

PATENTS COPYRIGHTS TRADE MARKS DESIGNS

U.S.PATENTS

Our facilities for securing patents enable us to give prompt and reliable service at reasonable rates. Inventors are invited to write to us regarding questions appertaining to securing patent protection. All matters receive prompt attention. Send sketch for preliminary examination.

Books free on request

A. M. BUCK & CO.

Patent Attorneys

205 Second National Bank Bldg.,
Washington, D. C.

PROTECT YOUR RIGHTS TO INVENTION

Write today for "Record of Invention," which contains forms to establish evidence of conception. Prompt personal service. Preliminary advice without charge.

J. REANEY KELLY
732-P Woodward Bldg. Washington, D. C.

PATENTS TRADE-MARKS AND COPYRIGHTS

Before disclosing an invention, the inventor should write for our blank form "EVIDENCE ON CONCEPTION." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention we will give our opinion as to its patentable nature.

Our illustrated Guide Book, "HOW TO OBTAIN A PATENT," sent Free on request.

Electrical Cases a Specialty Highest References Prompt Attention Reasonable Terms

FREE COUPON **VICTOR J. EVANS & CO., Patent Attorneys**

New York Offices: 1001 to 1007 Woolworth Bldg. Pittsburgh Offices: 514 Empire Bldg. Philadelphia Offices: 135 S. Broad St.
Main Offices: 779 Ninth Street, N. W., Washington, D. C.

Name..... *Address*.....

PATENTS

TO THE MAN WITH AN IDEA

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN, Patent Lawyer
164 Owen Building, Washington, D. C.
2276-8 Woolworth Bldg., New York City

PATENTS

LACEY & LACEY

Attorneys-at-Law—Patent Practice Exclusively
Solicitors of

U. S. and Foreign Patents
Trade-Marks, Copyrights
659 F St., N. W., Washington, D. C.
Write Us for Our Free Inventors' Book
PATENT-SENSE
Established 1869

Competent Patent Service
By a Former Examining Official of the U. S. Patent Office

NORMAN T. WHITAKER
Lawyer and Engineer
480 Whitaker Bldg. Washington, D. C.
Branch Office, 87 Nassau St., New York City.
INQUIRIES INVITED

PATENTS
Inventors Invited to Write for Information and Particulars
Highest References. Best Results.
Promptness Assured.
WATSON E. COLEMAN
Patent Lawyer
624 F Street N. W. Washington, D. C.

PATENTS
Hand Books on Patents, Trade Marks, etc., sent free. Our 70 years of experience, efficient service, and fair dealing, assure fullest value and protection to the applicant. The Scientific American should be read by all inventors.
MUNN & CO., 622 Woolworth Bldg., N. Y.
Washington Office, 622 F St., Washington, D. C.

PATENTS C. L. PARKER
Formerly Member Examining Corps, U. S. Patent Office.
PATENT LAWYER
McGill Bldg.
Washington, D. C.
Patents, Trade Marks, Copyrights, Patent Litigation
Handbook for Inventors, "Protecting, Exploiting and Selling Inventions," sent upon request.

tive buyer feels the need of a new tire iron. Sounding out several such men gives a fair idea of how keenly the public feel the want. This is very essential, from a financial point of view. It is possible for an invention to work perfectly, be a good manufacturing proposition and still not be received favorably by the public.

Often the original patents have expired before the public realized the merits of the invention. This was the case with the typewriter. Offices needed the typewriter, but there were no operators, and it was only after a long and tedious delay of developing operators, educating the public, and perfecting the machines that they became universally adopted in practice. Many of the original experimenters were dead before typewriters found their way from the inventor's shop.

Parallel with this is the modern steam turbine. Mr. Parsons' original patents expired before the turbine was considered seriously as a prime mover by the engineering profession. Mr. Parsons received his returns not from his patents but from his advanced knowledge gleaned from the experimental work which became a priceless asset in his later engineering practice. All this goes to show how important it is for the inventor to realize the condition of the public's wants. Many an inventor has been obliged to abandon an improvement because he could not stay in the game until the public realized its merits. Financial backers are liable to lose interest and withdraw their support if they have "come in" expecting a quick turnover, and it takes several seasons instead. Inventors are prone to be too optimistic about the public's receptivity of their invention and to paint such glowing pictures of success that their organization is sorely disappointed with the volume of business and the financial headway made in a given time.

If one meets a salesman he can adjust the conversation to get an idea of the selling capacity of the article. Will the article be *bought* or *sold?* It has been said there are no life insurance policies bought—they are all sold, and sold by personal solicitation of salesmen. One can describe the article and the plan he has for selling as if he were considering taking an agency himself and ask the salesman for his opinion. "Knights of the Grip" are always ready to pass an opinion, pick up a side line, or while the time away in conversation, so he will tell of any similar article that he may have seen and how it was marketed. If he is favorably imprest, remember him for the future selling force. He may cite to you several ways of marketing this from cases that have come under his observation. It is a very good plan for the inventor to have a feasible selling plan worked out before trying to interest capital.

From a manufacturer one can get some idea of the probable cost of production, necessary equipment, etc. The cost of manufacture is always more or less a stumbling block, but it is one of the three great questions that investors always ask. These are: What does it cost to manufacture, what does it sell for, and how long will it take to get it going? One can, if he likes, submit the whole article to a manufacturer and have him bid on it. But it is preferable to see what the cost of standard parts will be from a trade catalog, get bids on the other parts from screw machine works, stamping concerns, or others specializing in making parts. They will bid on the part in any quantity named from a blue print.

There is a type of man that one is bound to find in his travels, namely, the man with a lot of ideas. He will quickly commence: "I'll tell you what I would like to see and what I would buy if I could find it. I believe it can be done. It's a wonder to me some one has not done it already."

Such a man is often wide awake—he sees

(*Continued on page* 473)

PATENTS

INVENTORS: Send us sketches or a model of your invention and a description of the device for advice in regard to the best way of obtaining patent protection. Our practical experience covers a period of twenty years. Our hand-book on patents is sent free on request. All communications strictly confidential. Write us today.

TALBERT & TALBERT
Patent Lawyers
4287 Talbert Bldg. Washington, D. C.

PATENTS

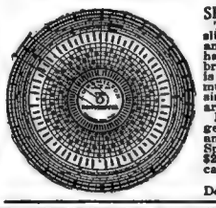
If you have an invention and desire to secure a patent, send for our Free Guide Book, HOW TO GET YOUR PATENT. Tells our Terms, Methods, etc. Send model or sketch and description for our opinion of its patentable nature.

RANDOLPH & CO.
Dept. 172 Washington, D. C.

Patents Promptly Procured
Send sketch or model for actual search of U. S. Patents. Highest references. Personal service. Moderate fees. Write for Free Patent Book.
GEORGE P. KIMMEL, Patent Lawyer
99-X Loan & Trust Bldg. Washington, D. C.

AMATEURS — INVENTORS
ELECTRICAL APPARATUS MADE TO ORDER COSTS NO MORE THAN READY MADE
and allows you to
WORK UP YOUR OWN IDEAS
KAUFMAN MACHINE COMPANY
1357 Odell St. New York City
Engineers Expert Instrument-Makers Designers

INVENTORS HAVEN'T YOU SOME IDEA that you can't just work out? Give us the idea—we will develop it for you. Mechanical and electrical ideas developed. Experts in model and experimental work and in perfecting inventions. Designing and building labor-saving machinery a specialty. Get in touch with us—we can save you money.
ELK MFG. CO.
1926 Broadway, New York



SPECIAL KON-VER-TER SLIDE RULE
The Hamilton KON-VER-TER slide rule has over 8000 graduations and over 1800 characters on it, will handle anything in Arithmetic, Algebra, Geometry or Trig. This slide rule is in use in all parts of the world and is much simpler to operate than others of similar lines. Does not require a wizard to use it.
Eventually you will get this rule, get it now and save the extra bother and expense. Utility rules $1.00. Special De Luxe, white ivory celluloid $2.50, instructions free. Leatherette case 50c extra.
J. C. HAMILTON & CO.,
Dept. B 7 Water St., Boston, U.S.A.

DOLLAR ADDING MACHINE

Adds and multiplies with speed of expensive machines. Seven columns capacity. Remarkably simple in construction. Nothing to get out of order. Weight one ounce. Made of metal and celluloid. The ideal pocket, desk or home machine. Order today. The best way not to forget is to do it now.
L. J. LEISHMAN CO., Dept. 142, Ogden, Utah

SAVE 25% to 60%
on slightly used
GRAFLEX-KODAKS
Cameras and Lenses of every description. Equal to new. Save money. Write now for
Free Bargain Book and Catalog
listing hundreds of money-saving bargains in slightly used and new cameras and supplies. All goods sold on 10 days' Free Trial. Money back if not satisfied. You take no chances dealing with us. We have been in the photographic business over 16 years. Write now.
CENTRAL CAMERA CO., Dept. 179 124 S. Wabash Ave., Chicago

FOR HEADACHE AND NEURALGIA
AK ANTI-KAMNIA TABLETS
10c & 25c PACKAGES
ASK FOR A-K TABLETS

Under-Water Surveying by Reflected Sound Waves

By H. Winfield Secor

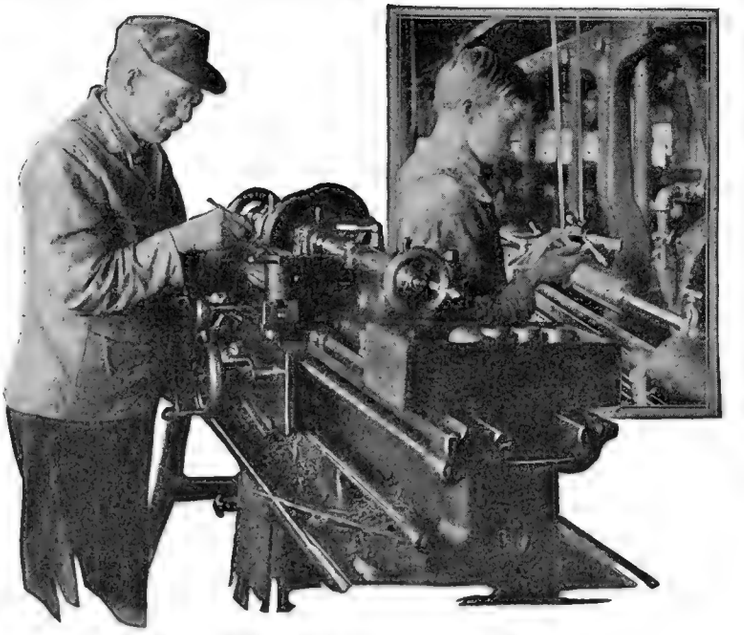
(*Continued from page* 454)

We remember one scientific investigator who could hear sounds as high as 38,000 cycles per second.

As Mr. Ries demonstrated, it is very remarkable how accurately a sound can be located, such as a blast from a whistle, if two short curved horns about one and one-half or two feet long are held tightly against the two ears, as shown in one of the accompanying illustrations. Should someone sound a whistle quite a distance away and you then swing your head from side to side, you will quickly ascertain that there is one certain position which will be found to be at right angles to the direction from which the sound emanated, in which a *maximum response* will be heard. It is possible that this method could be used to make a simple *range-finder* for military or other requirements. A very beautiful principle of pure physics was further mentioned at this juncture, and one that probably not one person in ten thousand ever thinks about. It deals with *sight* instead of sound, and the principle of triangulation is clearly illustrated thereby. Mr. Ries said: "Show me a good artist or draftsman and I will show you *the man who possesses abnormally separated eye-balls.*" This does not mean the eye-balls are divergent or convergent as in stigmatism, but that two normally straight eyeballs, having the most accurate observation possibilities, of extreme importance in all perspective drawing and painting, was here enhanced by the fact that the possessor of such a pair of eyes had a *longer base* for his triangulation of sight on a given object than the average man, or one whose eye-balls were spaced abnormally close. This fact is brought out pointedly by referring to the accompanying illustrations. If you are familiar with the laws of simple geometry and trigonometry, or else with the operation of the range finders now in use by the Army and Navy gunners, you will see that the reasoning is correct, and of momentous import indeed.

Mr. Ries's Under-Water Sound Detector.

There are two general methods by which Mr. Ries's highly perfected system of surveying may be carried out by means of sound waves. In the first method it may be applied in charting or surveying a given body of water and ascertaining the formation and character of bottom. In this case it is only necessary to provide at the receiving or measuring station a beam of known length on the extreme ends of which are placed two of the improved sub-aqueous microphones with balanced diaframs, perfected by the inventor. A sound projecting horn is sounded at pre-arranged intervals, and readings are taken as the apparatus is moved from point to point. In order to measure the range quickly, the two pivoted microphones are connected by means of gearing or rods with a calibrated dial placed in the center of the beam supporting the microphone sound detector. This dial moves proportionately to the movement of the microphone, and always gives the appropriate reading for identical angular positions of the microphones. The diaframs of Mr. Ries's subsea microphones are accurately balanced against the water pressure by comprest air, the pressure of which is automatically varied to a nicety in proportion to the pressure of the water, which, of course, increases as the depth of submergence is increased. The horns fitted on to the front of the microphones may also be attuned to a certain frequency.



For Two Generations

Inspectors, Toolmakers, Machinists and Apprentices have pinned their faith to the accuracy of

Starrett Tools

In the lathe room, at the bench, throughout the shop, wherever metal work requires precision measurement, you'll find men using Starrett Tools from preference.

Catalog No. 21LE sent free on request.

The L. S. Starrett Co.

The World's Greatest Toolmakers.
Manufacturers of Hack Saws Unexcelled.

Athol, Mass. 42-941

Attention Schools and Colleges

A WONDERFUL BARGAIN

The undersigned will sell at a very low cost, either in whole or part, the following:—

"Two 2-K.W. Marconi, 240 cycle sets of the old style with synchronous enclosed spark gap, complete with 110 volt generator, starter, field rheostat for the 240 cycle alternator aerial switch condenser, oscillation transformer, De Forest Commercial Type Audion Receiver, Marconi 2,000 ohm phones, Marconi 4,000 meter couplers."

These are two complete outfits which will be sold to the highest bidder and will make an ideal outfit for any school or university.

All of the appartus is in first class condition.

For further information, write to Mr. W. J. Gordon, International Milling Company, New Prague, Minn.

BOYS

Learn Drafting

Employers everywhere are looking for skilled draftsmen. They are offering good salaries to start with splendid chances for advancement.

Drafting offers exceptional opportunities to a young man because drafting itself not only commands good pay, but it is the first step toward success in Mechanical or Structural Engineering or Architecture. And drafting is just the kind of work a boy likes to do. There is an easy delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving boys just the training they need for success in Drafting and more than 200 other subjects. Thousands of boys have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon, then mark and mail it. This doesn't obligate you in the least and will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon now.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6200, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ MECHANICAL DRAFTING	☐ SALESMANSHIP
☐ STRUCTURAL DRAFTING	☐ ADVERTISING
☐ SHIP DRAFTING	☐ Show Card Writer
☐ ELECTRICAL DRAFTING	☐ Sign Painter
☐ ARCHITECTURAL DRAFTING	☐ ILLUSTRATING
☐ SHEET METAL DRAFTING	☐ Cartooning
☐ BOILERMAKER DRAFTING	☐ BOOKKEEPER
☐ BRIDGE DRAFTING	☐ Stenographer and Typist
☐ MACHINE DESIGN	☐ Cert. Public Accountant
☐ ELECTRICAL ENGINEER	☐ TRAFFIC MANAGER
☐ Electric Lighting and Railways	☐ Railway Accountant
☐ Electric Wiring	☐ GOOD ENGLISH
☐ Telegraph Engineer	☐ Teacher
☐ Telephone Work	☐ Common School Subjects
☐ MECHANICAL ENGINEER	☐ Mathematics
☐ Machine Shop Practice	☐ CIVIL SERVICE
☐ Gas Engine Operating	☐ Railway Mail Clerk
☐ CIVIL ENGINEER	☐ AUTOMOBILE OPERAT'G
☐ Surveying and Mapping	☐ Auto Repairing
☐ STATIONARY ENGINEER	☐ PLUMBING AND HEATING
☐ Marine Engineer	☐ Textile Overseer or Supt.
☐ ARCHITECT	☐ CHEMIST
☐ Contractor and Builder	☐ Navigation ☐ Spanish
☐ Concrete Builder	☐ AGRICULTURE ☐ French
☐ Structural Engineer	☐ Poultry Raising ☐ Italian

Name_____
Present Occupation_____
Street and No._____
City_____ State_____

Don't Grope for Words

We are all trying to SELL something—it may be brains, or automobiles, or soap—but words are the universal medium of exchange. LEARN TO USE THEM CORRECTLY—PROFITABLY. Get a command of English! Spend a few minutes daily with Grenville Kleiser's Mail Course, in Practical English and Mental Efficiency. It will surely teach you how to

Use Good English — *and Win*

Enlarge your Stock of Words—Use the Right Word in the Right Place—Write Compelling Business Correspondence, Stories, Advertisements, Speeches—Become an Engaging Conversationalist — Enter Good Society, etc.

Ask for free particulars *today*.
We send them by mail. No agent will call.
FUNK & WAGNALLS COMPANY, Dept. 313, NEW YORK, N. Y.

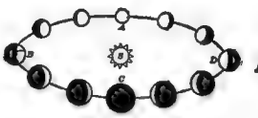
Where it is not possible to utilize a distant direct source of sound, as in measuring the distance of an iceberg, etc., then *reflected sound signals are used.* As afore-mentioned, a powerful siren or bell is now placed midway between the two microphones, and this is operated in the following manner: By means of an automatic *double contact switch* when the siren or submarine bell is sounded, to send out the *originating* sound signal, the circuits of the receiving microphones are automatically disconnected so that the powerful sounds being transmitted are not picked up, which would prove confusing, if for no other reason. After the signal has been sent out for a few seconds, the switch is thrown to "receiving," and the microphone circuits are re-connected. By this time the sound has died away at the transmitting station, and is being propagated toward the distant point from which the reflection is sought. After a few seconds, and during which time the pivoted beam supporting the two microphones is swung back and forth continually, a sound will be heard which is the echo, if there has been a reflection of the sound, and of course, if there is no reflection or echo, then no sound will be heard. The distance which the echo has traveled can be checked by a stop watch or other chronometer, dividing the time elapsed in seconds before the echo is heard, by two, and then multiplying this value by 4,700, which gives the range in feet. This is not necessary, however, as the automatic range reading scale connected to the two pivoted microphones is calibrated to give both the distance and position directly, once the beam has been swung so as to be at right angles to the point of the original sound, or in the present case the point from which the echo was reflected.

One of the accompanying views shows a diagram of Mr. Ries's *differential sound receiver* for this purpose, and its operation is very ingenious indeed. A differentially wound telephone receiver is used, provided with two windings or coils, one of the receiver coils connecting thru an induction coil as shown to one microphone, while the second receiver connects thru another induction coil and shunt circuit to the second microphone. What happens when a sound is received, is interesting. No sound is heard at all in the receiver, for the following reason:—When the microphones have been properly focust and the sounds localized and picked up in each microphone unit are equal in strength, then the currents passing thru the induction coil circuit to the two differential windings in the telephone receiver are arranged so that they neutralize one another, and as a consequence no sound is given forth by the receiver diafram.

An exceedingly important and timely application of Mr. Ries' invention is that brought about by the World War that is now happily ended, namely, the location and recovery of many of the numerous and costly warships and merchant vessels sunk by submarines, mines, etc., amounting, according to recent estimates,* to more than 18,000,000 tons out of a total world tonnage in 1914 of 42,000,000 tons. Among the original purposes which Mr. Ries had in view in devising his apparatus was the location and salvage of vessels and the preliminary study and charting of their position and condition, *from the surface,* by means of the reflected sound waves which were brought to a focus upon and caused to travel in exploration along the entire exposed part of the vessel, and also over the ground on which she lay. In this manner not only the exact depth and position of the ship is ascertained without the use of a diver, but every part of the ship is plotted as the survey proceeds. A three-funneled steamship, for example, with the widely separated sound receiver horns brought to *a spot focus* upon it, will give

* See article in "Sci. Amer.", July 19, 1919.

Young's Elements of Astronomy (Revised)



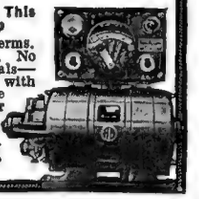
Brought strictly down to date. A general exposition of the subject and at the same time a valuable work for the reader or student who desires a reference book for constant use. It recognizes the new methods. It includes the new results. Amply illustrated, $2.00.

GINN AND COMPANY
70 Fifth Avenue New York

HB BATTERY CHARGING PAYS BIG PROFITS

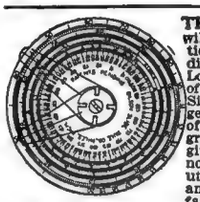
$100 to $200 CLEAR EXTRA PROFIT Each Month
New Lower Price On This HB 500 Watt Charger
Recharges 1 to 7 6-volt batteries at once for 10c to 15c each. Owner pays 75c to $1.50. Figure those profits! You can build a big, profitable business in battery charging. No mechanical knowledge required. Small investment—long, easy terms—BIG PROFITS.

Small Cash Payment Puts This HB Outfit In Your Shop



Balance on easy monthly terms. Profits easily carry payments. No burnouts, no expensive renewals—steady, dependable service with BIG PROFITS. Absolute Money-Back Guarantee. Tear out this ad and mail TODAY for information.

HOBART BROTHERS COMPANY
Box 91E Troy, Ohio
Successful Mfrs. Since 1893



THE MIDGET SLIDE RULE will solve any problem in addition, subtraction, multiplication, division and proportion. A Log-Log Scale gives any root or power of any quantity. Gives Logarithms, Sines, Tangents, Cosines, Cotangents and the decimal equivalents of fractions to six figures. It is grease and water proof and will give years of service. This rule is not to be compared with the paper utility rules which sell for $1.00 and are put together with paper fasteners. It is accurate, simple to operate and comparison shows that it is undoubtedly the fastest and most complete rule made. Our refund guarantee protects you from loss or disappointment. An instruction book 16 pages, 12 illustrations, is sent with each rule. Diameter of rule 4 in. Made in two models: Metal (white coated steel), $1.00; White Celluloid, $1.25. Leather Case 50c extra. Send for catalogue of Slide Rules. Your money back if you are not satisfied.
Gilson Slide Rule Co., Niles, Mich.

Build Your Own PHONOGRAPH,

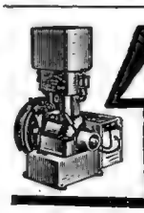
It's Easy With Our Help

A few hours interesting work saves many dollars and gives you a machine exactly to suit your ideals. We furnish motors, tone arms, case material, blue prints and full instructions. Plays any record. You can make fine profit building phonographs for your friends.
Write Today for Our Free Blue Print Offer. Agents wanted for our ready built Chorsleons.

SAVE OVER HALF

Choraleon Phonograph Co.
709 Menger Bldg., Elkhart, Ind.

NATIONAL TRADE DENTAL SCHOOL
506 S. Wabash Ave., Chicago, Ill.
LEARN MECHANICAL DENTISTRY—DEMAND UNLIMITED
A paying professional trade: You will be a trained dental mechanic and receive our diploma when competent. Students given advantage of thoroughly up to date laboratory, and services of graduate Dental Surgeons on practical cases. No effort spared to place graduates advantageously. No age limit. Day or Evening. Individual instruction. No educational requirements. No book or home study. Easy terms. Highest references. Especially attractive proposition to those who write at once for catalog H.



SMALL ENGINES

Perfected Gasoline Engines—½, 1 and 1½ h. p.—for Farm and Shop use. Price, $27.50 and up. Also,
WASHING MACHINES
We ship on trial. Send for Booklet and Special Offer.
SIEVERKROPP ENGINE CO.
1401—19th St., Racine, Wis.

STARTER for FORD CARS

EARN MONEY

Stamping Names on Key Tags. $50
Either sex. Spare time. Some make
Send 25c for Tag with your name on and instructions. Returned if required. **Exp. Key Tag Co., Cohoes, N.Y.**

three characteristic echoes as the pivoted exploring arm is moved.

Ries Balanced-Flame Sound Detector.

In this case two manometric flames, as shown in the accompanying illustration, are separated by an opaque partition inside of a ventilated glass bell or other cover. The two flames are adjusted to burn with equal brilliancy, and pneumatic comprest air tubes provided with appropriate needle tips are placed at the side of either flame. These two pneumatic tube systems, which are used to cause either of the flames to vary or quiver, are suitably connected to the two receiving microphone-telephones. While the microphones in this case are being focust, there will be a fluctuation of the flames until the beam is accurately focust and the sounds of the telephones are of equal strength, when the flames will become balanced, and each will burn with equal brilliancy and shape.

An interesting experiment, which the reader may like to conduct, is that of causing a focust sound wave to be propagated across a room, and then listening for the focust ray. This will demonstrate one of the principles on which Mr. Ries's invention works. To perform this experiment, all you need is a common garden variety of watch, such as a dollar Ingersoll, which gives a good healthy tick, and this may be placed in a parabolic or other reflector, or even a china oatmeal bowl.

Experimental Under-Water Signaling System.

All that is required for making this experiment is a water-tight tin box, in which is mounted a small buzzer. This buzzer may be soldered to the inside of the metal box, which may be a cocoa tin. The two wires carrying battery current to the buzzer are carried out thru the top of the container thru a piece of small rubber tubing. Where the rubber tube enters the box the joint may be tightly sealed by the liberal application of hot sealing wax. The lid of the box may be sealed tight by thoroly waxing with paraffin.

The receiver is of the microphone type, and any electrical experimenter will be able to make this device very easily with a little ingenuity. There are several ways in which it may be done. The first requisite is a sensitive carbon microphone. A Skinderviken microphone button, which is complete in itself, may be used, attaching it firmly to a ferrotype (iron) diafram about 2¾ inches in diameter. It is best to place solder over the nut on the water side of the diafram to keep the inner chamber of the receptor thoroly water-tight. The receptor may be mounted on a piece of pipe or a metal rod, so as to be suspended over the stern of a rowboat or launch, and provided with a handle so that the microphone and its attached metal horn can be swung in different directions. One side of the circuit may be completed thru the metal suspension of the microphone apparatus, and the other side of the circuit thru an insulated wire leading up above the water thru a rubber tube. All joints around the microphone should, of course, be made water-tight, but this is not very much trouble where a simple experimental apparatus is under consideration. The microphone diafram should be fitted with substantial rubber gaskets on front and back, and then the base of the horn and the rear casing of the microphone thoroly bolted together to form a compact whole by means of a number of small stove bolts or machine screws and nuts placed around the perifery of the chamber, as shown in the drawing. This is due to Christian Berger.

An ordinary 75-ohm telephone receiver, or a pair of them, are connected up with a dry cell or two in circuit with the microphone at the receiving station. All is then ready to try out the transmission of sound signals thru water.

DETROIT

The Auto Center is the Logical Place To

LEARN AUTO AND TRACTOR BUSINESS

Training for Head and Hand

Trained men are needed everywhere to test, repair and give expert advice on care and handling of automobiles, trucks and tractors. Big money for M. S. A. S.-Detroit trained men. Good jobs or independent businesses await our graduates. Opportunities unlimited.

Earn $100 to $400 Monthly

Our Course will teach you how in a few short weeks. Most complete, comprehensive and up-to-date Course known. Wholly practical. No job too hard for our graduates. Every phase of work covered. Actual experience given on dozens of different cars. Entire equipment best obtainable. Instruction includes complete Tractor Course. Brazing, Welding and Tire Repairing taught separately.

Learn in Detroit — Start Any Time — Our Graduates in Demand Here you get the benefit of finest co-operation of biggest factories. They know the thoroughness of our Course and gladly help our students in every way possible. Almost daily we have calls for graduates to fill responsible positions. School open all year. Enter classes any time. No need to waste or lose a moment.

Money-Back Guarantee We guarantee to qualify you for a position as chauffeur, repair man, tester, demonstrator, auto electrician, garage man, automobile dealer, or tractor mechanic and operator, paying from $100 to $400 monthly, or refund your money.

Big Factories Endorse Our School

They know what we do—how we teach, and the type of graduates we turn out and give our students unusual assistance. Every instructor an experienced man—one who knows and is able to teach others.

MAXWELL MOTOR COMPANY

DETROIT 1919.

Mr. James Williams, 20 Lincoln St., Gloversville, N. Y.

Dear Sir:—Your letter of February 22d, making inquiry regarding the Michigan State Auto School received.

Wish to say that this is one of the best schools in the country, and would not hesitate to recommend it to anyone. It is a recognized institution among the Automobile factories of this city. We have a great many graduates from this school in our employ and every one has given entire satisfaction.

Very truly yours,
MAXWELL MOTOR COMPANY, Inc.
CHALMERS PLANT.
H. H. Lee, Supervisor Welfare and Labor.

Get Free Catalog

Tells all about "The Old Reliable School" located in "the Heart of the Auto Industry." Or, better still, jump on the train and come to Detroit as hundreds do. Your fare refunded if everything not as represented.

MICHIGAN STATE AUTO SCHOOL

A. G. ZELLER, *Pres.*
669 Auto Bldg., Woodward Ave.
DETROIT, MICH., U. S. A.

DETROIT
THE HEART OF THE AUTO INDUSTRY
MICHIGAN STATE AUTO SCHOOL
THE AUTOMOBILE CENTER OF THE WORLD
44 AUTOMOBILE FACTORIES 140 ACCESSORY FACTORIES

YOUR OPPORTUNITY

Canceled Government Contracts

We have secured a large quantity of Small Motors, Generators and Charging Outfits. This material is new, still in original cases and carries the full factory guarantee.

This is Your Opportunity to buy new, guaranteed Electrical Apparatus of Standard Manufacture

1/2 H. P. INDUCTION MOTOR 110 or 220 volts, A. C. 60 cycle, single phase, 1750 R. P. M. **$32.50**

ALL MOTORS COMPLETE AS CUT

Battery Charging Outfits

For use on 110 volt, A. C., 60 cycle, single phase current only.

80 watts, 8 volts, 10 amperes . **$48.50**
150 watts, 30 volts, 5 amperes . **$68.50**
150 watts, 15 volts, 10 amperes . **$68.50**
300 watts, 30 volts, 10 amperes . **$94.50**

All outfits complete with switchboard as cut shown.

Mail $5.00 cash or Money Order. We will send C. O. D. subject to full examination.

MONEY BACK GUARANTEE

1/4 H. P. 110 volts A. C., 60 cycle, single phase 1750 R. P. M.

WASHING MACHINE MOTOR

Suitable for operating Small Compressors, Coffee Grinders, Bottle Washers, Lathes Drill Presses, etc. **$18.50**

WRITE FOR CATALOGUE. BARGAINS IN MOTORS AND GENERATORS. SPECIAL QUANTITY PRICES

220 volts **POLYPHASE MOTORS** 1750 R.P.M. 60 cycle, 2 or 3 phase. Complete, pulley and base
1 H. P. $59.50 3 H. P. $ 84.50
2 H. P. $72.50 5 H. P. $102.50

NEW MOTORS

110-220 volts **REPULSION MOTORS** 1800 R.P.M. 60 cycle, single phase. Complete with pulley.
1/2 Hp. $44.50 1 Hp. $67.50

MANUFACTURERS' DISTRIBUTER
CHAS. H. JOHNSTON - West End - PITTSBURGH, PA.

What 15c will bring You from the Nation's Capital

Washington, the home of the Pathfinder, is the nerve center of civilization; history is being made at this world capital. The Pathfinder's illustrated weekly review gives you a clear, impartial and correct diagnosis of public affairs during these strenuous, epoch-making days.

The little matter of **15c** in stamps or coin will bring you the Pathfinder **13** weeks on trial. The Pathfinder is an illustrated weekly, published at the Nation's center, for the Nation; a paper that prints all the news of the world and tells the truth and only the truth; now in its **26th** year. This paper fills the bill without emptying the purse; it costs but **$1** a year. If you want to keep posted on what is going on in the world, at the least expense of time or money, this is your means. If you want a paper in your home which is sincere, reliable, entertaining, wholesome, the Pathfinder is yours. If you would appreciate a paper which puts everything clearly, fairly, briefly—here it is. Send **15c** to show that you might like such a paper, and we will send the Pathfinder on probation **13** weeks. The 15c does not repay us, but we are glad to invest in new friends. **The Pathfinder, Box 76 Washington, D. C.**

MODEL AIRPLANE SUPPLIES

Build and fly Model Airplanes ~

Send 5¢ for catalog of complete and knocked-down scale models of new machines, parts, fittings, and supplies.

Wading River Mfg. Co. 672 Broadway, Brooklyn, N.Y.

MURDOCK No. 55

2000 OHM DOUBLE SET **3000 OHM DOUBLE SET**

$4.00 **$5.00**

Your Decision

is good enough for us. If, after trying a set of MURDOCK No. 55 'phones, you decide that they do not suit your requirements, send them back and get your money. We are certain that you will say that these 'phones are the best value in the world.

Guaranteed to be as sensitive as you require, more reliable than most, and as serviceable as any. They compare very favorably with sets costing from two to three times as much.

ORDER YOURS NOW

BULLETIN 19A describes these 'phones and a complete line of thoroughly good experimental apparatus. Send for a copy.

WM. J. MURDOCK CO.

55 Carter Street
CHELSEA, MASS.
221 Second St., San Francisco

CORE WIRE

We have been fortunate in securing thru auction several tons of guaranteed pure, double annealed **Norway Iron Core Wire** and are selling this wire to "Experimenter" readers

At Pre-war Prices, 20cts. lb.

This wire is just the thing for spark coils, transformers, etc., and it is, of course, a very much more superior product than the usual iron wire.

We have only one size left:
24 INCHES LONG.
Thickness about No. 21 B and S

If this size should be too long we advise cutting the wire down yourself by means of shears. As long as the supply lasts we offer this wire as described above to our customers at the very low price of 20c a pound. Add postage or we will ship express collect. Order at once.

Electro Importing Co., 231 Fulton St., N.Y.C.

"Audions on A. C." Correction

In the article entitled "Operate Your Audions on A. C.," by Elliott A. White, published in the July issue of the ELECTRICAL EXPERIMENTER, page 234, an error occurred in the statement of the formula in the center column of page 234. The multiplying factor in the numerator of the equation should have read 6.25 instead of .625. Also the second line at the top of column three should have read 1 ampere instead of 0.5 ampere.

We are pleased to add the following information contributed by Mr. White since the publication of the original article, and which we believe our Radio friends will be very glad to procure, especially in view of the high technical standing of the author, who was formerly Radio instructor at the *Carnegie Institute of Technology*. The additional information follows:

"If the tubes of the rectifier are of the high internal impedance type, they must pass at least as much current as is required by the plate circuit of the receiving tubes; and if the tubes of the rectifier are of the low internal impedance type (such as the G. E. Co.'s *Tungar* tube), a current-limiting resistance should be inserted in the lead from the middle of the transformer windings T3 T4, to protect the tubes. As the filaments of these tubes require only 2 volts, but a correspondingly heavy current, the transformer windings T5 T6 would have to be wound for 2 volts with heavy wire. There is another simple way of connecting the rectifier to the transformer, whereby all the windings are in series and the plates in parallel, but to avoid confusion this method is not given. Any connection or design adopted by the experimenter is satisfactory, so long as it is adapted to the kind of tubes used, whether they are transmitter tubes, receiver tubes, commercial tubes, or home-made ones."

TRENCH USE OF TELEPHONE WIRE.

Telephone wire is the *sine qua non* of the trenches. It is used to hang pictures on the walls of the dugouts, to mend cots and to make them. Men who have been "over there" have said that frequently soldiers have stopt in their pursuit of the Hun to gather bits of telephone wire lying along the blood-soaked fields of No Man's Land.

De Forest Defends His Three-Electrode Audion

(*Continued from page 428*)

gave off torrents of negative electricity. This discovery was made before anything was known of electrons, but Dr. Fleming had persisted in his efforts, directed towards rectifying alternating high frequency currents, and eventually by an exceedingly pretty contrivance, was able so to control and study the current as to suppress all the oscillations in one direction by the Fleming valve. This was improved on later by Mr. Marconi, and the present three-electrode valve, with its contrivances for audio-magnification, three times repeated, was finally evolved. Two currents being coupled and exalting each other made an exceedingly sensitive detector, and the lecturer remarked that this might be tested by placing the receiver and the transmitter of a telephone together, when all the little noises in the room were picked up and a whistling sound produced. Thus, with the modulation of the waves to the human voice, the problem of radio-telephony was solved, and great developments were to be expected.

"Conversation with ships would be practicable, as man to man in the same room, and also Trans-Atlantic telephony. The Premiers of the Dominions would, he anticipated, be able to take part in a cabinet meeting in London by vocal intercourse, tho their bodies were thousands of miles away."

The protest of Dr. de Forest is contained in the following letter:

Editor of *Morning Post*,
London, England.

Sir:

I have just read the paragraph in your issue of February 25th entitled "The Future Telephone," a resume of a Cantor lecture by Prof. Fleming. Prof. Fleming's lectures have usually been so clear and instructive that I am astonished to see him now quoted as having made statements widely at variance with well known facts. In the recent testimony before Mr. Justice Spencer in the unsuccessful attempt before his court by the Marconi Company experts to prolong the "Fleming valve" patent it was admitted by the Marconi experts (Prof. Fleming himself being present at the trial) that the Fleming valve did not amplify, that it only rectified the weak currents received in wireless signalling.

As a matter of fact, well known to radio engineers, the true Fleming valve has itself been of exceedingly small value in the modern wireless art. And Fleming did not improve it. It is a three-electrode vacuum tube, called by myself, shortly after its invention, the "Audion," which, if I may say it in all modesty, has brought about all those wonderful advances in radio signalling.

The Audion and not the Valve made possible the trancontinental wire telephony —the Audion and not the Fleming Valve, used as an oscillator at the transmitter, and as detector, and then amplifier at the receiver stations made possible transoceanic radio telephone in 1915, and again this year between New Brunswick, N. J., and the S. S. *"George Washington"* in Brest Harbor.

I cannot believe that a scientist of Prof. Fleming's standing would knowingly lend his name to any deliberate attempt to mislead the public in stating, or artfully inferring that Marconi improved the Fleming valve and produced the three-electrode device. Neither do I believe that a paper of the standing of the *London Morning Post* would knowingly lend its columns to any unfairness or pettiness in withholding the credit due an American inventor, altho there always has been and there still is plenty of evidence to show such an unfair and petty attitude on the part of certain British interests, especially in the United States. Marconi had no more to do with inventing a three-electrode device or Audion than the Kaiser, altho both have made good use of it, since an American produced it and demonstrated its limitless possibilities.

In the interest of fair play and scientific fact, I ask you to publish this communication. (Signed) LEE DE FOREST.

CORRECTION NOTICE.

Courtesy for the photographs used in illustrating article entitled "Airplane Antenna Reels" on page 324 of the August issue, should have been given to Emil J. Simon, Inc.

THE HEART OF THE WIRELESS ON THE NC 'PLANES

Fleming Pat. No. 803684
De Forest Pat. Nos. 841387-879532

Also used on the Vickers Vimy Trans-Atlantic Flight

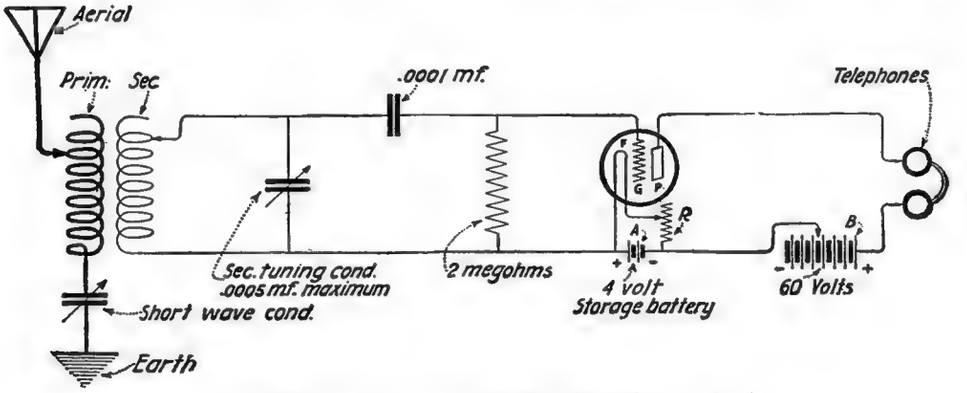
MARCONI V. T.

$7.00 each

Standardized Socket - - - - - -- - $1.50 additional

Agreements recently effected have made vacuum tubes available for experimental use. The Marconi V. T. is the only vacuum tube, or audion, which may be sold to amateurs, laboratories, schools of instruction and experimenters.

A highly developed, all-around tube for use as a detector and amplifier in wireless communication. It has practically the same electrical constants as the tube used by the Allied armies and navies throughout the war in continuous wave transmission and reception.



The preferred detection circuit for the Marconi V. T.

The Approximate operating life of the MARCONI V. T. is 1,500 hours.

Class I—Designed for use as a detector; operates with plate potential of 20 to 60 volts.

Class II—Designed for use as an amplifier; plate potentials from 60 to 110 volts may be applied.

Tubes in either class may be used for detection or amplification, but those of Class I are best as detectors, and Class II tubes are superior as amplifiers.

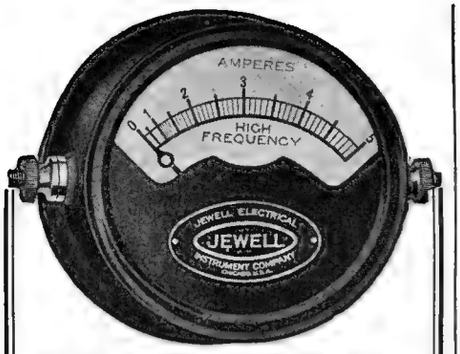
Send all remittances with order to

COMMERCIAL DEPARTMENT

Marconi Wireless Telegraph Company of America

Sole distributors for De Forest Radio Telephone & Telegraph Co.

Woolworth Building, 235 Broadway, New York



RADIO FREQUENCY AMMETER

4 inch Face

0 to 3, 0 to 5 or 0 to 10 Amperes. Specify Reading Required.

$11.00 Net

The Jewell Electrical Instrument Co. is prepared to fill the instrument needs of the amateur experimenter in radio and general electrical work, as well as those who desire more precise and accurate measurements of electrical quantities.

We show above our high frequency ammeter, of the thermo couple type, especially desirable for medium sized installations.

For receiving panels, we are supplying small D. C. instruments for plate voltage and filament current, at a very reasonable price.

Write for our special radio instrument bulletin.

JEWELL ELECTRICAL INSTRUMENT CO.
1640 Walnut St. Chicago

WIRELESS!

KNOB AND SWITCH LEVER—Mounted on brass bearing and shaft, threaded 6-32, two inches long. Lever securely fastened to knob. Each 40 cents, postage 4 cents.

KNOBS as illustrated above as used on Switch 1¼x¾ with hole for mounting, each 20c postpaid.

CONTACT POINTS 7/32x7/32 Brass with screw for mounting. Postpaid 25c per doz.

Bakelite-Dilecto panels, about

9½ x 19 x ¼	Black XX	$4.00
19 x 19 x ¼	Black XX	8.00
9½ x 19 x 3/16	Black XX	3.00
19 x 19 x 3/16	Black XX	6.00

A. H. CORWIN & CO.
924 Kinney Building Newark, N. J.

Get Our Prices

on the Wireless Apparatus you need, before buying.

We handle new and second hand instruments on which we can save you money.

All Second Hand Instruments guaranteed to be in perfect working order.

WHAT DO U NEED?

Send us your list now

Radio Equipment Co.
630X Washington St. Boston, Mass.

The "Fog Warning" Radio Telephone

(*Continued from page* 426)

third repetition the warning, "You are getting closer, keep off!" is sent out with a limit of range of about two miles. These signals are sent out during fog, mist, rain, and falling snow.

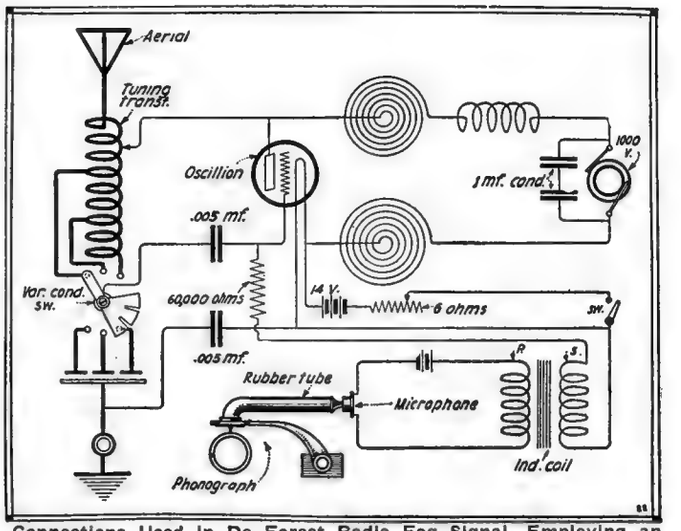
When sent out by *radio* the signals can be heard with any suitable or well-known wireless telegraphic telephonic receiving apparatus which may be employed to receive, detect, or reproduce the emitted or radiated signals. Crystal detectors may be used. The signals are sent out now on a first wave length of 600 meters.

If the transmitting and receiving apparatus is equipt for graduated strength musical note signals, these will be received by a ship at sea; for instance, suppose the ship receives the note corresponding to the Middle "C"; then it will be known that the lighthouse is four miles away.

If both the middle "C" and the "E" and "G," are detected at the receiving station, the distance is two miles, and if all four notes are heard, then the distance away is one mile or less, and so on for any other pre-arrangement and adjustment of the sounding apparatus.

This invention is bound to be a great help to all mariners and the system is a direct innovation over any that have heretofore been tried. Doubtless many disasters and wrecks will be avoided and in general to make navigation safer.

Every important lighthouse and lightship on the U. S. coasts will be fitted with this new Radiophone "fog signal."



Connections Used in De Forest Radio Fog Signal, Employing an Oscillion Bulb to Generate the Transmitting Oscillatory Current.

EMIL J. SIMON WINS CANADIAN LAWSUIT.

The Marconi Wireless Telegraph Company of Canada, Limited, the plaintiff in a Canadian radio patent suit, recently released and discharged the American Wireless firm of Emil J. Simon from and against all claims and demands set forth in the Statement of Claims, and further stated in their disclaimer that it will not institute any other proceedings against the defendant, Emil J. Simon, in respect thereof. This notice was dated Montreal, June 7th, 1919.

A competent English authority says that English central station managers realize that lighting is fast becoming the small end of the electric central station's income, and power and appliances are to be the main sources of revenue in the future.

The How & Why of Radio Apparatus

By H. Winfield Secor

(*Continued from page* 431)

comprising a four-wire inverted "L" aërial, the wires being spaced about 2½ feet apart.

However, where long distances are wanted, it becomes necessary to use longer aërials.* The reason for this is that, to gain the highest maximum results in any radio transmitting or receiving circuit, the antennae oscillatory circuit down to earth should be able to vibrate at a frequency approximating its natural period. Hence, it is seen that for this reason, it is necessary to use a long aërial, having in consequence a long wave *natural period* in order to pick up efficiently such wave lengths as 12,000 or 15,000 meters. This is not the whole story, either, for another important factor is that the longer the aërial, the more energy will be picked up from the rapidly moving etheric wave front, as it passes across the antenna wires. This may be compared for analogy to the electromagnetic field. In a dynamo or motor you will recollect that the longer the wire, the more magnetic flux it will intercept in its rotation in the field, with a consequent greater potential produced in the moving conductor. In the case of radio transmission, the conductor is stationary, while the electrostatic field moves and thus cuts the wire, inducing an electric current in the wire. It is this induced current which operates the detector in the receiving set.

*See "Calculation and Measurement of Inductance"—in the September, 1917, issue of this journal.

As a guide to the young radio designer, the accompanying graph chart is given, which shows the natural wave lengths of four-wire antennae of various heights and lengths. These values were computed from data given by Dr. Louis Cohen. A common rule for calculating approximately the wave length in meters of a simple antenna system, without any coils or other apparatus connected with it, is to multiply the length of the flat-top, plus the length of lead-in wire to earth, in meters by 4.5. This rule applies to inverted "L" type aërials. It is also applicable to "T" type antennae, but here the length of wire considered in meters is the lead-in length to earth, plus *one-half the length of the flat-top.* The factor 4.5 varies under different conditions, as, for instance, where metal roofs may change the natural capacity of the antenna. But it serves very well for approximation, and has been very extensively used.

Mathematical Calculation of Antennae Wave Lengths.

In a previous paper the writer had the following to say in regard to the wave length of radio antenna and the value of tuning inductances in the aërial oscillatory circuit.

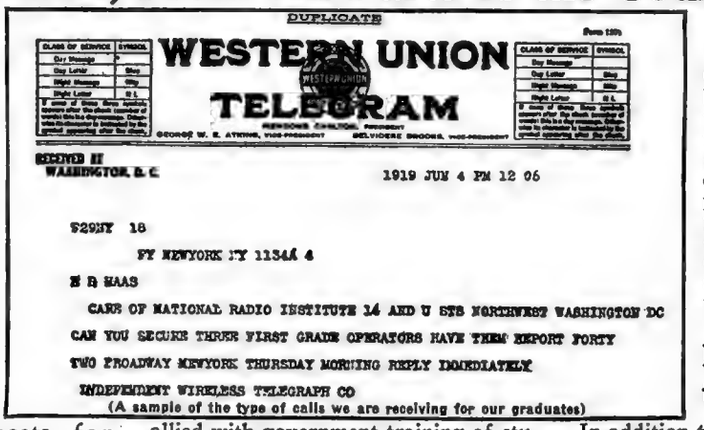
Having thoroly discust the methods of both calculating and measuring the inductance of coils, we are now in a position to continue with the design of the most im-

(*Continued on page* 464)

Wireless Operators Wanted-At once

Calls Coming In Steadily, For National Radio Institute Graduates, From All Parts of the Country.

COMMERCIAL Radio has arrived and thousands of positions are now opening up in the Merchant Marine, Aerial Mail and Land Station Service, Railroad Companies, Lake and Ocean Steamship Lines. We are now receiving requests for more National Radio Institute Graduates than we can furnish.



DUPLICATE

WESTERN UNION TELEGRAM

RECEIVED AT WASHINGTON, D. C. 1919 JUN 4 PM 12 06

S29NY 18

NY NEWYORK NY 11344 4

E R HAAS

CARE OF NATIONAL RADIO INSTITUTE 14 AND U STS NORTHWEST WASHINGTON DC

CAN YOU SECURE THREE FIRST GRADE OPERATORS HAVE THEM REPORT FORTY TWO BROADWAY NEWYORK THURSDAY MORNING REPLY IMMEDIATELY

INDEPENDENT WIRELESS TELEGRAPH CO

(A sample of the type of calls we are receiving for our graduates)

Salaries Up to $250 A Month

With exceptional opportunity for promotion to Radio Mechanic, Electrician, or Engineer. No previous experience or training is necessary. You can learn Wireless the National Radio Institute way, in Ten Weeks, by mail, right in your own home. With our help you can quickly qualify for a good position at big play. Many of our students secure positions before completing the course, because it is based on actual practice and teaches what is needed to make a big success of Wireless work.

Get Your Instructions from the Nation's Capital

(Our Course is Endorsed by the U.S. Goverment Officials)

The National Radio Institute headed by authorities who have been closely allied with government training of students, was established in 1914 and is the first school in America to successfully teach Wireless by Mail. The work is under the direction of J. E. Smith, E.E., director of the Radio Department Howard University, and E. R. Haas, formerly of the Radio Division of Yale University.

We now have students throughout the world. Our location in the Nation's Capital together with the standing of our officers and their wide acquaintance among government officials connected with Wireless activities place us in position to give our students the best instruction obtainable and to be of the utmost help in assisting them to secure good paying positions.

Travel and See the World

If you want to travel and see the world—go to foreign countries, and increase your knowledge of world affairs Wireless offers you the chance of a lifetime. However, you are not obliged to travel, but may secure a permanent position at one of the big Land Stations, Railroad, Telegraph, or Steamship Companies if preferred.

Pay As You Learn

Our plans of payment bring a wireless education within the reach of anyone who desires to learn. A small payment down on our convenient payment plan, and small following payments, often enables our students to earn the cost of their tuition while actually learning to be a wireless operator.

Free Instruments to Every Student

In addition to 5 text books—35 Special Lessons, and 18 Personal Examinations we send you, while taking our course a Standard Automatic Wireless Transmitting and Receiving Set for sending and receiving messages. These fine instruments are Free only to National Radio Institute Students.

Oldest Wireless School in America

In addition to being the oldest and largest Wireless School in America our location in the Nation's Capital enables our Students Employment Department to keep in close touch with the best openings for our graduates. A Post Graduate Course is given Free to every graduate. Special discounts are allowed to discharged soldiers, sailors, and marines with former wireless experience and to Radio amateurs.

Representatives wanted to help introduce our course to wireless enthusiasts

FREE

Our booklet "Wireless the Opportunity of Today," gives you complete information in regard to our course, the quick and easy methods by which you can master wireless, and other important facts you should know. It is free. Just mail the coupon. No obligation whatever on your part.

Mail This Coupon Today

National Radio Institute
Department 92
Washington, D. C.

Send me free of charge, your booklet, "Wireless the Opportunity of Today," with full particulars regarding your famous 10 weeks Home Study Course, and your Special FREE INSTRUMENT OFFER.

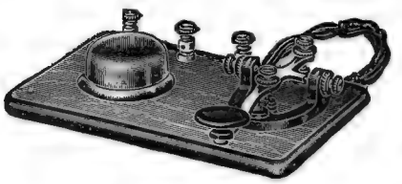
Name .....

Address .....

Town..... State.....

Wireless Receiving Ban Raised

MESCO WIRELESS PRACTICE SET



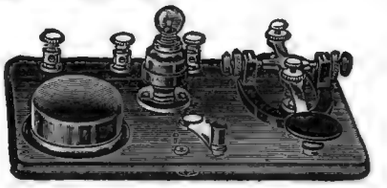
The Practice Set comprises a regular telegraph key, without circuit breaker, a special high pitch buzzer, one cell Red Seal Dry Battery, and four feet of green silk covered flexible cord.

The key and buzzer are mounted on a highly finished wood base, and three nickel plated binding posts are so connected that the set may be used for five different purposes.

List No. Price
342 Telegraph Practice Set, with Battery and Cord $3.24
Weighs 4 lbs. packed.
Price does not include postage.

MESCO Combination Practice Set for Learning the Morse and Continental Visual and Audible Codes

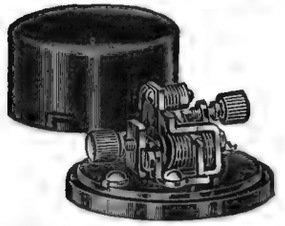
This outfit is the only reliable instrument which will enable students to become proficient operators in the U. S. Naval Service, because it is equipped with a buzzer and miniature lamp enabling the user to master both the visual and audible signals quickly.



List No. 52—Practice Set with Red Seal Battery and Cord $4.05

Weighs 4 lbs. packed. Price does not include postage.

MESCO RADIO BUZZER



This buzzer maintains a constant note and is recommended as an exciter for checking wavemeters where pure note and ample energy are required.

It consists of practically a closed circuit field of low reluctance, having a steel armature to which is riveted a strap supporting a movable contact. The armature tension is adjustable by means of a screw with a milled head large enough to be easily and permanently adjusted with the fingers. The stationary contact is adjusted by means of a similar screw. The magnet coils are connected in series with a total D. C. resistance of 3.9 ohms. Shunted across these coils is a resistance having a D. C. value of 3 ohms. This shunt eliminates all sparking such as occurs at the break on ordinary radio buzzers and the energy saved thereby is transferred into any oscillating circuit connected to it, the result being that this buzzer as constructed radiates five times more energy than any other existing type. All connecting wires liable to be broken are eliminated. Contacts are of genuine platinum, which is essential in order to maintain a constant note. The parts are mounted on a Condensate base to insure constancy in operation.

Diameter 2 in., height 1¼ in. The cap is attached to the base by a bayonet joint.

List No. Price
55 Mesco Radio Buzzer $2.05

We carry a Large and Complete Line of Standard Wireless Material Recognized by Experts as such with Competent Experienced Wireless Attendants in Charge

Send for the New Edition of Our Catalog W28

It is pocket size, contains 264 pages, with over 1,000 illustrations, and describes in plain, clear language all about Bells, Push Buttons, Batteries, Telephone and Wireless Telegraph Material, Electric Toys, Burglar and Fire Alarm Contrivances, Electric Call Bells, Electric Alarm Clocks, Medical Batteries, Motor Boat Horns, Electrically Heated Apparatus, Battery Connectors, Switches, Battery Gauges, Wireless Telegraph Instruments, Ignition Supplies, etc.

Manhattan Electrical Supply Co., Inc.

17 Park Place, New York, N. Y.

CHICAGO
114 S. Wells St.

ST. LOUIS
1106 Pine St.

SAN FRANCISCO OFFICE: 604 Mission St.

FOUR FAMOUS BOOKS

Wireless Course in 20 Lessons

By S. Gernsback, A. Lescarboura and H. W. Secor. E. E.

A course that tells you everything you can possibly want to know about "Wireless". The mysteries of "Wireless" are unfolded to you by the use of such simple language so skillfully used that of necessity you must understand every word. The subject is not treated superficially, however, for there is a whole lesson devoted to the Theory and Mathematics of this epoch marking subject.

Size of book is 7 x 10¼ in., 160 pages, 350 illustrations, 30 tables.
Flexible cloth cover....per copy $.50
Stiff cloth cover.....per copy 1.00
Postpaid

Experimental Electricity Course in 20 Lessons

By S. Gernsback and H. W. Secor. E. E.

A Course of the theory and practice of Electricity for the Experimenters. This is undoubtedly one of the most complete and comprehensive treatises of this special subject ever published. The book is written by the same authors as the famous "Wireless Course in 20 Lessons".

Every phase of experimental electricity is treated comprehensively in plain English.

The book contains 160 pages and more than 400 illustrations.

Flexible cloth cover...per copy $.50
Stiff cloth cover.....per copy 1.00
Postpaid

No. 1. How to Make Wireless Sending Apparatus
No. 2. How to Make Wireless Receiving Apparatus

By 20 Radio Experts.
Two Remarkable Books

Book No. 1 contains 100 pages, size 7 x 5 in. and 88 illustrations, paper bound.

Book No. 2 contains 100 pages, size 7 x 5 in. and 90 illustrations, paper bound.

These two books have been written and published entirely for the wireless enthusiast who wants to make his own radio apparatus.

Book No. 1—How to make Wireless Sending Apparatus 25c
Book No. 2—How to make Wireless Receiving Apparatus.....25c
Postpaid

THE EXPERIMENTER PUBL. CO. Book Dept. 233 Fulton St., New York

The How & Why of Radio Apparatus

By H. Winfield Secor

(*Continued from page* 462)

portant type of inductance coils used in radio work. We will confine ourselves to the types of coil which are mostly used, namely—loading inductances, loose couplers, variometers and transmitting oscillation transformers.

Before we delve into the actual design of these coils, however, let us first consider the fundamental facts necessary for the design. Since the inductance is employed in building up the proper oscillating condition of the circuit and consequently the wave length, we can express this relation by the following formulæ:

We have first the formula expressing the wave length, *W.L.*, of the open (antennae) oscillatory circuit, thru the primary, L_o, of a loose coupler, loading or tuning coil.

$$W.L. = A\sqrt{L \times C}\ ; \qquad (1)$$

where:—

A = a variable, ranging from 38.15 to 59.6 for short wave length. (See curves for various values of "*A*" in article cited below in February, 1917, issue.)

L = total inductance in centimeters of aërial, including lead-in and loose coupler, tuning coil or loading coil.

C = capacity in micro-farads of aërial, including lead-in.

Those interested in this subject should refer to the excellent article on "The Design of Large Radio Receiving Transformers," by C. S. Ballantine, in the February, 1917, issue of this journal, page 732. The variable factor, 59.6, appearing in the usual wave length formulæ was there discust at length, with a graph giving the different values of this function for various wave lengths and aërial inductance to localized inductance ratios.

Considering long wave lengths (10,000 meters and higher) and the design of large loose couplers we are safe in using the expression:

$$W.L. = 59.6\ \sqrt{L \times C}\ ;$$

where:—

L = inductance of loose coupler primary and loading coil (if used); the inductance of the antennae being neglected, owing to its small value compared to the inductance of the loose coupler (or loading coil).

C = Capacity of antennæ, including lead-in.

For designing short wave apparatus we shall call L_o the value of the loose coupler (or tuning coil) primary inductance. Then we have:

$$L_o = \frac{\lambda^2}{3552 \times C} - L\ ; \qquad (2)$$

here:—

L_o = inductance of load (loose coupler, tuner, etc.), in centimeters.

λ = maximum wave length to be tuned to.

L = inductance of antenna and lead-in in centimeters.

C = capacity of antenna and lead-in in micro-farads. (See tables herewith for these values.)

For long wave apparatus, let L_o represent the loading coil inductance, plus the inductance of the loose coupler primary (or tuner, if used). Then we have the formula:

$$L_o = \frac{\lambda^2}{3552 \times C}\ ; \qquad (3)$$

with all values the same as in formula No. 2.

The following tables will be found useful in applying the above equations to the design of loose couplers, etc.:

TABLE "A"

Cap. in M.F., Including Lead-in, of 4 Wire Inverted "L" Aerials. Wires Spaced 3 Ft. Apart

Height	Length of Flat-top in Feet			
	60	80	100	120
40....	.00033	.00042	.00051	.00060
50....	.00035	.00043	.00050	.00058
60....	.00036	.00044	.00051	.00059
70....	.00037	.00045	.00052	.00059
80....	.00039	.00046	.00053	.00060
90....	.00040	.00048	.00055	.00061
100....	.00042	.00049	.00056	.00062

TABLE "B"

Inductance in Cms., Including Lead-in, of 4 Wire Inverted "L" Aerials

Height	Length of Flat-top in Feet			
	60	80	100	120
40....	35,000	41,100	47,200	53,310
60....	48,800	55,460	62,090	68,700
80....	62,400	69,320	76,300	83,300
100....	76,260	83,500	90,750	98,020

It is possible to determine approximately the inductance required to produce a desired wave length when the capacity of the total oscillating system is known. When using any of the above formulæ, it should be remembered that they include the *total value* of the unit. Thus, the capacity factor includes the antenna, and condenser capacity, each of which must be determined separately and the capacity of the antenna must be obtained by actual calculation, formula for deriving this quantity having been given on page 732 of the February, 1917, issue of this journal, as well as a table of the capacities of a four wire antennæ of different lengths and heights.

The first step in the design of an inductive tuner (having determined the wave length) is the actual size of the instrument, and from this to find the approximate dimensions of the winding tubes to be used. Having these on hand, and knowing the maximum inductance of the primary by equations (2 or 3), we can immediately determine the number of turns that the primary coil will require to obtain the wave length sought, by solving equation (3) of (Part 1, March, 1917, issue) for *N*.

The inductance of the secondary winding should be such that its wave length should correspond very nearly to the antenna circuit, and that of the primary. If this condition is to be obtained, then we have an ideal condition of maximum efficiency and great care must be exercised in bringing about this ideal condition. The value of the secondary inductance must therefore be in the neighborhood of the primary (unless it is to be shunted by a variable capacity), but in practise it is made somewhat larger than that of the primary. It is customary in coupler design to allow one-half inch difference in size of diameters between the primary and secondary tubes and therefore the diameter of the secondary can readily be determined The number of turns required is deduced from equation given in the September, 1917, issue.

Details of Aërial Construction.

When it comes to discussing details of amateur aërial construction, one could almost write an encyclopedia of several volumes, for in traveling about the country, it is amazing to note the many different ideas followed in building antennæ. This is so for many reasons, not simply because one Radio Amateur wishes to have something different from his fellow Amateur across the street, but in a great majority of cases his pocketbook controls the design. And so it is that instead of using beautifully molded ten-inch Electrose insulators on his aërial, you may perchance bunk into one of the greatest freaks of modern times, a real dyed-in-the-wool Amateur antenna—constructed from about six kinds of wire, including some good old iron hay-baling wire, and a variety of insulators that would win first prize in any freak photo contest, made from miscellaneous odds and ends,

"ASK ANYONE WHO HAS USED IT"

WENT THROUGH CHATEAU-THIERRY, ARGONNE AND MEUSE OFFENSIVES

A soldier who used a Brandes Headset all through the war brought it to us for slight repairs afterward. He *knows* that a Brandes is the best that can possibly be made. You ought to hear him talk. (Name on request.)

BRANDES WIRELESS HEADSETS

CLEAR TONE
LIGHT WEIGHT
DEPENDABLE SERVICE

Score 100% efficiency in actual use. Sharp, Unblurred, Readable Signals assured by

Superior" Set 2000 ohms, $6

"BRANDES MATCHED TONE"—

Exactly matching the tone of both receivers in each set and thus eliminating all confusion due to unmatched harmonics.

TRIAL OFFER *Brandes Wireless Headset sent to you on trial for 10 days. Test it,—compare with others,—for sensitiveness, clearness, distance. Prove for yourself the fine quality, the "matched tone." The two diaphrams, toned exactly alike, strengthen the signals and prevent blurring. Used by many U. S. Gov't experts, and experts abroad; by colleges and technical schools; and by professionals and amateurs everywhere.*

If, for any reason, you are dissatisfied, your money back without a question.

SEND 4c FOR CATALOGUE E.

C. BRANDES, Inc.
Room 814
32 Union Square
New York City, U. S. A.

WIRELESS RECEIVER SPECIALISTS

Complete Line of Brandes Receivers for those in Canada. Send stamp for Pamphlet "E"
Radio Electrical Supply Co., 43 McGill College Avenue, Montreal, P. Q., Can.

ELECTRICAL ENGINEERING

Bachelor of Science Degree in Three Years. Accomplish your electrical ambition. Three years of intensive conscientious study here will train you to become an Electrical Engineer with a degree of Bachelor of Science. Electrical industry demands technically trained men—engineers. At home or abroad the field is widening by leaps and bounds.

Forty professors, expert in their lines, form our faculty. They are leading hundreds of ambitious young men to sure Success. **Why not you?**

In fully equipped laboratories, shops, drafting rooms and recitation rooms day by day you will become fully prepared to engage in the profession of Electrical Engineering.

Fall Term Opens Oct. 1st

"Earn While You Learn" if you wish. Full provision for securing deficient high school credits.

Clip the coupon now for a "Photo Story" book and bulletin of the College of Electrical Engineering.

SCHOOL OF ENGINEERING OF MILWAUKEE
College of Electrical Engineering
110-373 Broadway Milwaukee, Wis.

CLIP HERE

School of Engineering of Milwaukee
Milwaukee, Wis.

Gentlemen:—Without obligation, send me catalog, Photo-Story book and particulars concerning your 3-Year Electrical Engineering Course with B.S. Degree.

Name .....
Address .....
City ..... State .....
Age ..... Education .....

SCHOOL OF ENGINEERING OF MILWAUKEE
110-373 Broadway Milwaukee, Wis.

HOME BATTERY CHARGING

means vitality and long life to your battery and anyone can do it with the

NEW F-F BANTAM BATTERY BOOSTER

which will fully charge any 6 volt storage battery eF-Ficiently from 100 to 130 volt 60 cycle alternating current lamp socket.

This is a new size of F-F Rectifier and similar to our standard F-F Magnetic Rectifiers which have been on the market for over 3 years. Thousands in use giving satisfactory service. Simple, safe, sure acting. Copper and carbon electrodes rectify the current. Capacity 6 volts 8 amperes. Shipping weight 10 pounds. Price complete with Ammeter and Battery Clips $15. Also F-F Battery Charging Rheostats that operate from Farm Lighting Plants and Direct Current Service.

Send check for prompt shipment via express or if via parcel post add sufficient for postage and insurance. Bulletin 12 on request.

$15

THE FRANCE MANUFACTURING CO., Cleveland, Ohio

WHY PAY

for a course of study in wireless telegraphy when our unique plan of profit sharing with our students guarantees a large saving on tuition and an estimated return of all?

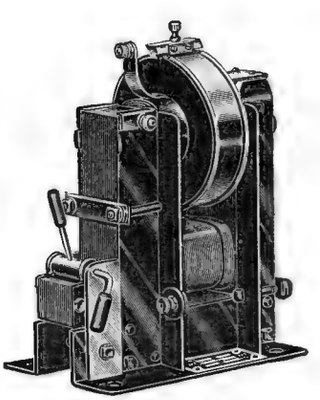
Our Correspondence Course

is most thorough and we are placing all our graduates in good positions without one day's delay. We represent several large steamship companies and are actually paying students to complete our course and obtain their licenses, the demand on us for operators is so great.

We are now the largest and best equipped radio school in the world, although some with less than one-fifth the number of students claim this distinction.

SERVICE RADIO SCHOOL

Dept. E, 900-2 Pa. Ave. Washington, D. C



RADIO AMATEURS

Do you want your radio station listed among the "long distance" amateurs? Our new type "R" 1 K. V. A. 25,000 volt Wireless Transformer will make your station efficient for "long distance" relay work. Write for our catalog 20 T describing complete transmitting apparatus.

Thordarson Electric Mfg. Co.

501 S. Jefferson St. Chicago, Ill.

including beer—excuse us, *near-beer*—bottles, porcelain cleats, waxed wooden rods, pieces of crockery and other choice bits of "backyard junk."

So it is seen that there is a wide latitude in ideas, and good ones, too, in many cases, let it be said, for building an experimental wireless antenna of fair efficiency. Your average Radio Amateur does not care so much about the "looks" of his antenna as he does about the fact as to whether or not he can sit down in his little coop with his apparatus about 10 P. M. and hear "Carnarvon" calling one of his Britannic Majesty's cruisers lying off the Canadian coast! That's the life that cheers.

Figs. 5 and 6 show several practical and approved developments in aërial design, which are not only efficient, but simple as well, in their application. Fig. 5 shows a typical elevated aërial spreader, which may consist of a length of stout bamboo, or a very good spreader is composed of cypress or oak sparring, about two inches square. The best shape for the spar is to make it about four inches broad at the center, so as to give it greater strength against bending. For ordinary work the Amateur usually winds several turns of wire around the spreader, and then fastens his insulators to it. A good construction, however, is afforded at very small cost by having a blacksmith (or else you can make them yourself) bend up a few eye-bolts, as shown in Fig. 5. These may be made from ⅝ inch round, wrought-iron bar, threaded at one end and provided with a washer and a nut or two. The iron and wood work on the aërial should be thoroly painted, of course, before erection, so as to withstand the weather. A heavy red or white lead paint is advised. If the antenna is to be used for "Receiving" only, four insulators are placed at both ends of the flat-top at the spreaders. Where the very highest efficiency is desired, extra insulators may be placed in the suspension ropes holding the spreader, as shown at X. This is the standard of aërial construction, but a much simpler form which has been extensively used in commercial practice, on ship stations particularly, is that shown in Fig. 6. Here no insulators are used in the flat-top part of the aërial proper, but they are placed in the main suspension ropes, as shown at X. This insulating scheme effectually insulates the aërial, of course, and a piece of brass or iron pipe may very well serve as a spreader, connecting the wires of the flat-top to the pipe, by winding the ends of the wires around it. It is the best practice to run a jumper wire across the strands, soldering this thoroly at the joints. This applies to the free end of the antenna; no jumper wire being required at the opposite end, where the lead-in rattails are led off. In any case all joints in the aërial circuit thru which radio frequency energy has to pass, *should be carefully soldered*, or else a very good design of clamp should be used, packing the cleaned wire joint with tin-foil before tightening the clamp. The jumper and rattail connections for inverted "L" and "T" type aërials are clearly shown in Figs. 1 and 2.

Kind of Wire to Use in Aërials.

"What kind of wire should I use for constructing my aërial?" "How many feet long?" and "What altitude?" are questions frequently repeated, and these are not simple ones, either. However, the Radio Experimental fraternity may count itself lucky in the respect that the size of wire for the antenna is pretty well standardized. For Amateur antennæ, it is common to use a wire corresponding in size to No. 14 B. & S. gage solid conductor. Where stranded cable is used, and which possesses a much lower *high frequency* resistance than a solid conductor of equal diameter (owing to its greater surface area, which

is the only part of the conductor traversed by the radio frequency currents), then a seven-strand cable is commonly employed. Seven strands of No. 22 or 24 wire constitute a common size of cable for experimental work, while a heavier cable is used in building commercial and Government stations. There are several kinds of wire in use for aërial construction. Aluminum wire was used previously, but it is very difficult to make a good soldered joint with aluminum wire, and for several other reasons it has not been used very much in latter-day practice. A very good wire for amateur work is a plain solid copper conductor, No. 14 B. & S. gage, or heavier, which may or may not be tinned. A good stranded cable for this work is one comprising seven strands of tinned copper wire. Another standard cable is a seven-strand one composed of phosphor bronze stock, which is of course very strong and suitable for the extra long spans. Still another form of wire in use for experimental aërial construction is copper-clad steel wire, which possesses greater tensile strength than any other equal size electrical conductor. The radio-frequency currents pass thru the outer copper jacket. Plain iron wire alone has been used, but is not very satisfactory.

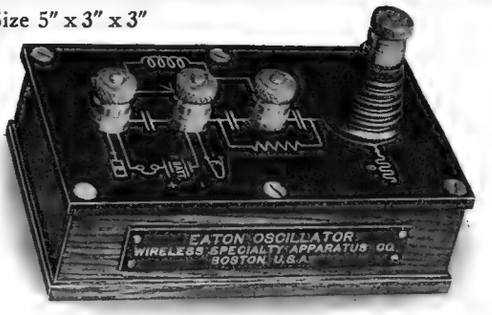
Grounding Connections.

The matter of grounding antennæ, especially of the elevated type, is very important, markedly so in the case of *thunder-storms*. Also the *Fire Underwriters'* rules have to be carefully heeded in this respect, which apply to every building on which *fire insurance* is carried. The safest method to follow in any event, for your own protection, as well as keeping in conformity with the Fire Underwriters' rules, covers the following recommendations for the *grounding of radio antennæ*.

These regulations call for a ground wire connected to a first-class ground plate or pipe running down to damp earth, or to the street side of water mains in cities, this ground wire being composed of No. 4 B. & S. gage solid copper conductor. The ground wire connects to a grounding switch rated at 600 volts and 100 amperes. The regulations do not specify what size of lead-in conductors should be used, but it is apparent and obvious that if you intend to conduct a heavy static surge or induced charge from a thunder-storm down to earth thru this massive switch and ground wire, that you certainly would not make a lead-in of No. 14 gage wire, like so many amateurs have been wont to do in past years. The right way to do this is to construct the lead-in wire of No. 4 B. & S. gage solid copper conductor or its equivalent in cross-sectional area, such as by employing two or more wires of smaller size stranded together. Good Radio Engineering practice calls for rattail leads brought down from each strand of the aërial to be of equal cross-sectional area to the aërial strands proper, and then bunching these rattail leads into the lead-in joint at the bottom of the fan-tail construction. All of these joints, as aforementioned, should be SOLDERED. The rattail leads should be brought into an aërial connector of some kind before being soldered, so as not to depend upon the solder alone for mechanical strength or electrical conduction.

The *Fire Underwriters'* rules further stipulate that this lightning ground and switch should be placed on the exterior of the building in all cases, and furthermore, that this *ground* which has just been described in detail, should be separate from the station ground. It is the usual practice in experimental radio stations to place the aërial grounding switch either on the window-sill or on the side of the window, and, of course, it should be covered with a metal or other box, so as to protect it from rain

Size 5" x 3" x 3"



THE EATON OSCILLATOR
FOR EXPERIMENTERS

Designed to transform receiving circuits to receive arc and other undamped signals. It may be used across circuits whose inductance lies between .05 and 100 M.H. and whose capacity lies between .0003 and .005 m.f.

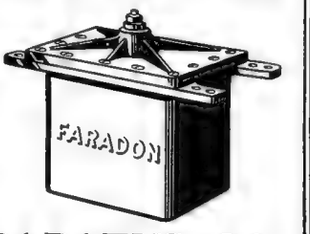
Requires no adjustments of any kind. Circuits are engraved on top. Only one variable, the tuning condenser, is required.

The simplest and cheapest way of receiving arc, tube and high frequency alternator signals.

PRICE $14.90 IMMEDIATE DELIVERY

THE .004 M.F. FARADON MICA CONDENSER

Comparative tests have proved the W.S.A. mica FARADON to be the best primary transmitting condenser made. FARADONS are built in .002 m.f. and .004 m.f. capacities. The .004 m.f. FARADON is tested for 30 minutes at 21,000 volts and 18 amperes in a circuit of 1000 meters electrical length.

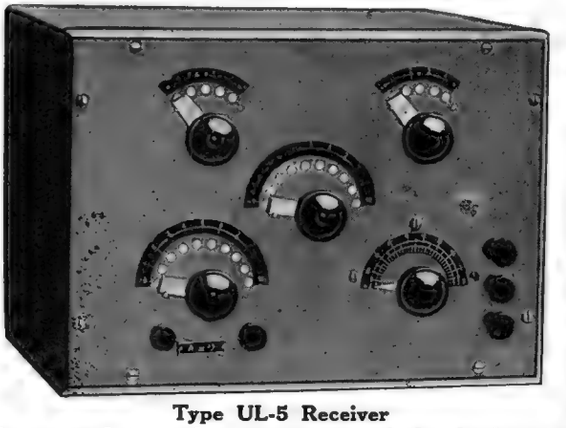


The temperature rise during this period is less than 3.5°C. Every condenser is guaranteed for one year.

.004 m.f. FARADON $28.50 Immediate Delivery

WIRELESS SPECIALTY APPARATUS CO.
ENGINEERS, DESIGNERS, MANUFACTURERS
Boston, Mass., U. S. A.

UNIVERSAL RADIO APPARATUS



Type UL-5 Receiver

It is the policy of this company never to consider a sale completed until the customer is thoroughly satisfied. Incidentally our instruments seldom fail to satisfy, because they are scientifically designed and built on honor. If you are interested in radio apparatus of the highest grade at fair prices, enclose a 2-cent stamp for our catalogue.

Type UL-5 Receiver.

This is a complete receiver for undamped waves up to 17,000 meters. No external coils, couplers or condensers are needed, since it is entirely self-contained. Sizes 8" x 12" x 7" approximately.

We control the patent rights for the Mignon System and can supply these instruments.

UNIVERSAL RADIO MANUFACTURING CORP.
Dept. W Elmira, N. Y.

AMPLIFY YOUR RADIO SIGNALS

With the new DETECTAGRAPH-TRANSMITTER, the amateur can amplify radio signals to such an intensity that he can hear the signals about his station without the need of the telephone head set.

By the addition of a loud talking telephone he is able to hear the messages many feet away from the instrument.

The super-sensitive DETECTAGRAPH-TRANSMITTER herewith shown is two and three-eighths inches in diameter, five-eighths of an inch thick and weighs less than three ounces. It is the most sensitive sound detecting device ever brought before the public.

The manner in which the amplifying process is attained is by attaching with tape the DETECTAGRAPH-TRANSMITTER to the regular wireless receiver.

Not only is this instrument applicable for amplifying radio signals, but it can be used with equal satisfaction for magnifying other sounds. Phonograph music can be transmitted from one place to another by means of this instrument, and those who are afflicted with deafness will find enormous benefit by using this transmitter. It is the greatest device for building your own loud talking telephone, detectagraph and other devices. Can be used for any purpose where a sensitive detecting instrument is required.

SUPER-SENSITIVE Detectagraph MICROPHONE DEVICES

Our Super-Sensitive Detectagraph Transmitter. Price, $7.00 Complete

Our Special No. 25 Loud Talking Receiver. Price, $4.00 Complete

Detectagraph Rheostat, especially made for amplifying circuits. Price, $2.00 Complete

Super-Sensitive No. 40 Receivers to be used in connection with Detectagraph-Transmitters, $10.00

The Detectagraph Junior Deaf-Phone $15

Equal to any $35 instrument made. Outfit consists of Super-Sensitive Transmitter with cord connector; Super-Sensitive Ear Piece with small black cord; Black Single Headband; Black Case and Two Batteries.

Model "B" Horn, with Loud Talking Receiver, Cord Plugs and Desk Stand Base. Price, $10.00 Complete

Model "C" Horn, with loud talking Receiver, Cord Plugs and Wall Base. Price, $10.00 Complete

Detectagraph $15

This detecting instrument of marvelous sensitivity can be used for detecting secret conversations. Outfit consists of Sensitive Transmitter, 25-ft. Black Cord, Receiver, Headband, Case and Battery.

Order direct from ad.

Or write for free descriptive circular.

G. BOISSONNAULT COMPANY

26 CORTLANDT STREET NEW YORK CITY

Makers of Super-Sensitive Microphone Devices

DEPENDABLE KNAPP ELECTRIC SPECIALTIES

Motors and Electrical Specialties Are Best

Knapp Goods have stood the test for 29 years. No detail in construction has been spared to make them the best that money can buy. The complete Knapp line includes Toy and Power Motors, Generators and Dynamos. Specialties and Novelties that amuse and instruct. Fans, Rheostats, Compasses, etc. And Knapp prices are always lowest. Always insist on Knapp Goods.

KNAPP "LEARNELECTRICS"

A complete Electrical Laboratory, including a very valuable instruction book by H. P. Gorman, A.I.E.E. Covers all subjects clearly and concisely.

KNAPP DYNAMO MOTOR

Will electroplate, charge storage batteries, run lamps, motors, train of cars, induction coils,—in fact, the number of experiments it can be used for is unlimited. Runs on 4 to 6 Volts or can be connected to run on 110 Volts through a transformer.

Price, Complete, $7.00

Price, Complete, $3.50

Order to-day. Or your dealer can secure them for you. DESCRIPTIVE CIRCULAR and CATALOG of celebrated **KNAPP MOTORS** *and Electrical Specialties from 10c up mailed FREE on request.*

KNAPP ELECTRIC & NOVELTY CO., 523 West 51st Street, New York City

VACUUM TUBES
In Wireless Communication

The only book on the subject. Written by E. E. Bucher, author of "Practical Wireless Telegraphy". Price $1.75.

Wireless Press, Inc. 233 B'way, N. Y.

Arnold **Loose Couplers**

Combination Loose Coupler Parts and accessories.

Send 3c stamp for literature which is sure to interest you.

J. F. ARNOLD 2082 Lexington Av. N.Y. Established 1910

and snow. In running the ground wire down the side of a building, it need not be insulated and bare copper wire is generally employed. Fig. 4 shows one form of efficient ground for lightning protection or for the regular station grounding purposes. This ground is composed of a piece of galvanized chicken wire buried from three to five feet in the earth between two layers of charcoal. The depth to which the ground plate is buried will depend upon how dry the top soil is. *The ground plate must be placed in wet earth,* no matter if it has to be buried twenty feet deep, unless some provision is made to keep the earth in this vicinity moist, such as by daily watering, or else by allowing a waste pipe from some water system to empty over the spot.

Types of Masts.

When it comes to masts or towers for supporting the elevated type of antenna, there are many different styles. One of the latest events in radio is the "Tree Aërial," as devised by Maj.-Gen. George O. Squier, which was described in detail, with special drawings, in the July, 1919, issue of the ELECTRICAL EXPERIMENTER.

This represents one form of natural elevation for supporting aërials or aërial conductors at a considerable altitude, and another one is the balloon or box kite. The average Radio Amateur does not care so much about details on the construction of radio masts, for in practically all cases he will follow his own intuition in making use of whatever material and facilities he may happen to have on hand. For example, some antenna masts used in the past have been of the latticed wood form of construction, while others of the iron pipe type have been erected to considerable heights. We remember one mast of iron pipe construction in the vicinity of New York City which rose to a height of 110 feet. For safety's sake, such a mast should not be constructed with too small a pipe at the base, and for altitudes of 75 to 100 feet, the first and second base sections of the mast should comprise standard heavy wrought iron pipe not less than 3 to 3½ inches in diameter. Needless to say, the iron pipe should be either galvanized or else thoroly painted before erection, and very carefully guyed by stranded steel cables attached ⅓, 2/3 the altitude and at the top. Long guy wires should be split up into sections not exceeding 20 feet, by means of strain insulators.

Aërial Insulators.

Various forms of commercial and home-made aërial insulators are shown in Figs. 7 and 8. Fig. 7 illustrates the commercial, fluted type of molded Electrose insulator, as well as the Electrose ball insulator. Where greater efficiency is desired, several of these insulators are connected in series to give a high resistance. Porcelain cleats are often used in constructing small experimental antennæ, and serve the purpose quite well. Another detail shown in Fig. 7 is an aërial insulator made from a piece of hard rubber, polished or unpolished (Bakelite is best), the two ends of which have threaded screw eyes as indicated. A tin or galvanized iron water shield is made to clamp at one end of this hard rubber insulator in order to ward off rain, and thus keep the insulator in a better working condition during inclement weather. It is absolutely impossible to obtain any long distance results for *transmitting* or *receiving* with rain pouring down on the insulators; for a considerable amount of the energy induced in the aërial conductors will leak to earth thru the water covering the insulators. The commercial radio companies have overcome this difficulty by placing cable shields on the antenna insulators in this fashion in a great many instances, and undoubtedly will use more of them as this fact is better appre-

ciated. Figs. 7 and 8 show novel ideas for constructing antenna insulators from porcelain tubes. Of course, the small tubes are not of much use, generally speaking, but the large size tubes, measuring about 12 inches long by 1½ inches in diameter, are cheaply purchased, and make very good insulators. Of course, the main question here is "How can the screw-eyes be securely anchored?" and several suggestions are given in the drawing herewith. In one case the screw-eyes have their lower ends twisted spirally with the largest diameter at the base, so as to hold firmly in molten sulfur; or the screw-eye may be held by slotted wooden blocks cut so as to expand and wedge against one another inside the tube. Fig. 8 shows a detail drawing for making a pair of brass or iron clamps which will make a very substantial aërial insulator from any stout porcelain tube.

THE HOW AND WHY OF RADIO APPARATUS.

Series to Date.

No. 1. *The Induction Coil, Page* 493, *November,* 1916.

No. 2. *The Transformer, Page* 656, *January,* 1917.

No. 3. *Condensers, Page* 735, *February,* 1917.

No. 4. *Spark Gap, Page* 113, *June,* 1917.

No. 5. *Radio Transmitting Inductances, Page* 537, *December,* 1917.

No. 6. *Radio Receiving Tuners, Page* 685, *February,* 1918.

No. 7. *Radio Receiving Condensers, Page* 766, *March,* 1918.

No. 8. *Detectors, Page* 30, *May,* 1918.

No. 9. *Telephone Receivers, Page* 176, *July,* 1918.

No. 10. *Radio Amplifiers, Page* 472, *November,* 1918.

No. 11. *How to Make and Use a Direct-Reading Wave Meter and Decremeter, Page* 874, *April,* 1919.

Radio men everywhere will undoubtedly like to obtain the complete set of these specially prepared papers on the "How and Why of Radio Apparatus." Also the following three important and timely papers on the "Calculation and Measurement of Inductance," by Mr. Secor and Samuel D. Cohen.

Nos. 1, 2 *and* 3 *"Calculation and Measurement of Inductance," appearing in the March, April and September,* 1917, *issues.*

Those interested in these valuable papers can obtain prices of individual back numbers containing them by writing to the "Circulation Department."

In closing, it may be said that the Amateur Radio man will learn much by close observation and the application of common sense and everyday electrical technique to his antenna structures. Don's use faulty lead-in insulators to bring the aërial current into your radio shack—buy a good one, even tho it costs a few dollars. An excellent one is that made of molded Electrose, with threaded tightening flanges. A hole drilled thru the center of a piece of glass, hard rubber or bakelite sheet, at least one foot square, makes a very excellent lead-in insulator. Don't tie your aërial so tight that in a wind-storm it will break at the first swing; suspend one end by a counterbalance weight, or else by springs, so that the flat-top can expand at least 5 to 10 feet in a 100- to 150-foot span. Watch your aërial's behavior in your first wind-storm and you will learn more than by reading several books on the subjects.

ARE YOU IN THE RACE

FOR POSITION -- POWER -- SUCCESS?

There is no "handicap," All contestants are eligible

ALL YOU NEED IS GRIT—DETERMINATION—

TRAINING!

At the School of Engineering of Milwaukee can be secured the specialized technical training prerequisite, if you would win to success in the great electrical field. *Special One Year Course in Practical Electricity.*

Expert instructors, extensive and perfectly equipped laboratories—careful, scientific combining of theory and essential practice—these and many more desirable features have guided hundreds of ambitious young men to the success for which they have striven.

Are You Less Ambitious Than They?

Resolve to enter the race at once. Right Now! Get in line by clipping the coupon *today.* No matter what your previous education, there's a starting place for you here. Every phase of electrical instruction taught in a way to benefit and aid you to success. R. O. T. C.—Physical Director—Fraternity House with Board and Room at Cost to Students.

Mark and mail the coupon for the new "Photo-Story," bulletins and full particulars concerning the course that interests you.

School of Engineering of Milwaukee
105-373 Broadway, Milwaukee, Wis.

"An Electrical Technician's Institute"

Scissors here

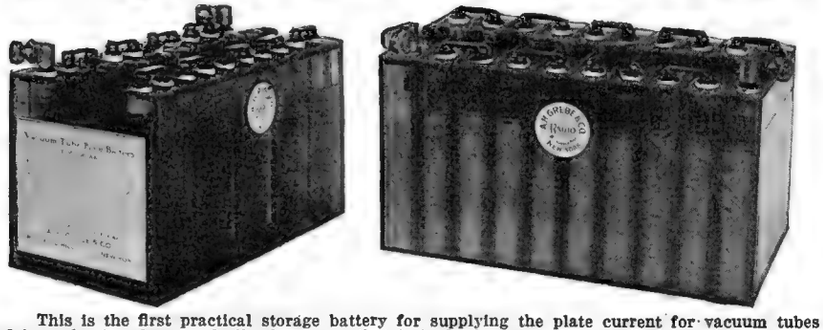
School of Engineering of Milwaukee,
105-373 Broadway, Milwaukee, Wis.

Gentlemen:—Please send me, without obligation, a "Photo-Story" and full information concerning the courses marked.

Electrical Engineering (B.S. Degree 3 Yrs.)
Electrotechnician Course — 6-Month Trade Courses
1 Yr. Practical Electricity — Home Study Courses
1 Yr. Electrical & Mechanical Drafting

Name.....
Address.....
City.....State.....
Education.....Age.....

Announcing the New Grebe Vacuum Tube Plate Battery



This is the first practical storage battery for supplying the plate current for vacuum tubes and is so far in advance of all other types that it is destined to maintain the leadership.

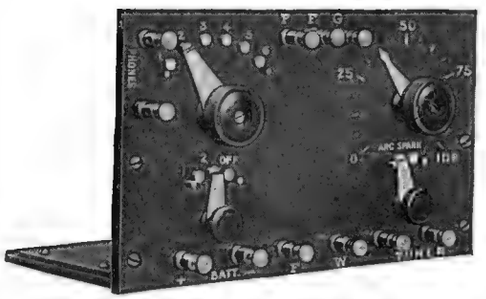
The numerous advantages of the lead cell are fully characterized in this battery. The construction is rugged; the plates are of the best design and workmanship; the individual cell-casings are made of transparent Pyralin and welded together to form a solid unit. Its capacity of 3 ampere hours is sufficient for supplying current to a number of tubes simultaneously while assuring peak voltage operation for long periods of discharge. With this battery, charging from A.C. sources is easily accomplished with any type of "Tungar" rectifier without changing any of the windings.

TYPE ROAA—with liquid electrolyte $17.50
TYPE ROAB—with non-spillable electrolyte 19.50

Send for literature on this and other new Grebe developments.

A. H. GREBE & CO. Richmond Hill, N. Y.

AUDIOTRON
VACUUM TUBE PANELS
PARTS AND ACCESSORIES



Panel full XX Grade Continental Bakelite Dielecto Steel cut and whitened engraving. All metal parts heavily nickeled. Switches for double filament tubes and arc or spark reception. New type Back mounted smooth running rheostat. Panel also furnished in maple with imitation black bakelite finish.

No. 8B.	Full Bakelite panel assembled.....	$15.00
No. 8BP.	Complete set of parts.....	12.00
No. 8W.	Wood panel complete	12.50
No. 8WP.	Complete set of parts.....	10.00

Send for free bulletins on panels, couplers, detectors, parts, etc.

Send cash with order and save all delivery charges. Dealers: write for proposition.

AUDIOTRON SALES CO., 311 Lick Bldg., San Francisco

DUCK'S BIG 300 PP. Wireless & Electrical

Catalog is now as it always has been, the largest and most complete and dependable Wireless Catalog published. Mailed for 12c in stamps or coin which may be deducted on first order of one dollar. Catalog not sent otherwise. This catalog costs us twice the price of other catalogs.

Everything in wireless *worth while* is listed in this catalog. The experienced amateur will tell you to see our catalog before buying. You are thereby insured against an unwise purchase. It is the *Beacon Light* to guide you right in the selection of your wireless apparatus. No bigger or better values are obtainable elsewhere. Send for revised price list. It is yours for the asking.

THE WILLIAM B. DUCK CO., 230-232 Superior St., Toledo, Ohio

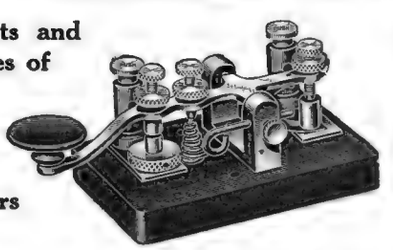
Manufacturers of Reliable Instruments and Distributors of All Prominent Makes of

RADIO APPARATUS

Everything essential to the successful installation of a radio station.

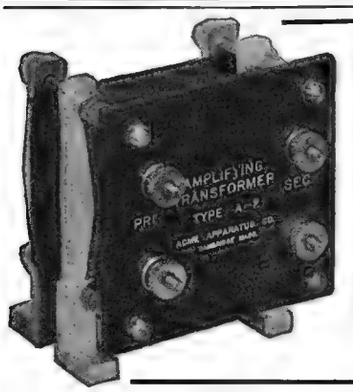
Bunnell Apparatus is Sold by Dealers Everywhere

Catalog 40-E on Request.



A Special Feature, The Straight Line Radio Key.

J. H. BUNNEL & CO. 32 Park Place, New York



Acme Apparatus For Results

THE ACME AMPLIFYING TRANSFORMER Type A-2

A very compact and efficient transformer especially designed for repeating between tubes in Vacuum Tube Amplifier Circuits.

Two-winding, closed magnetic type. Primary and secondary of No. 40 enamelled wire, wound on one leg, with a turns-ratio proved by exhaustive experimentation to be the best. Supported on aluminum castings, with bakelite panel and nickel-plated binding posts. Shipping weight, 2 lbs.

Type A-2 Ampylifying Transformer, $10.00
Same, unmounted 7.50

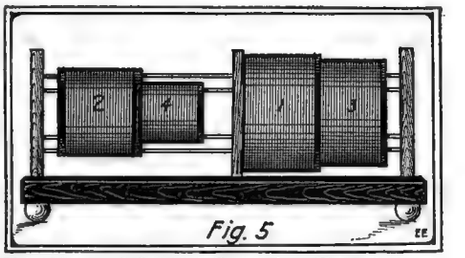
Inquiries solicited from responsible dealers.

ACME APPARATUS COMPANY
28 WINDSOR ST., CAMBRIDGE, MASS.

Eccentric Antennae

(*Continued from page* 432)

the general efficiency of the aërial, but serves to protect it from corrosion. As to the relative merits of the two kinds of wire, there seems to be some doubt. The operaters using each kind declare their own particular kind the best.

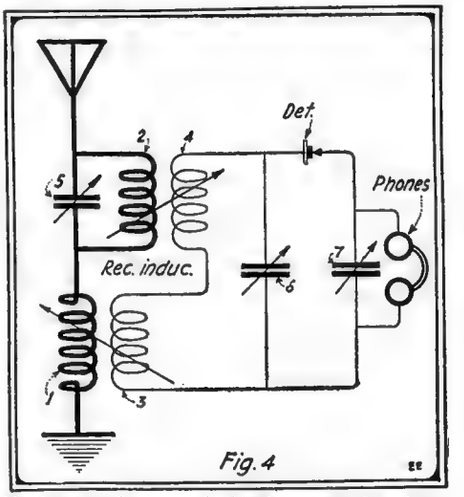


Side View of Special Receiving Transformer Having Four Coils. 1 and 2 Are Primaries, While 3 and 4 Represent Secondaries. This Affords Very Fine Tuning.

There has also been some discussion as to the relative merits of the two forms of aërial—i.e., the *flat-top* and *barrel* types. There is no doubt, however, that the barrel type has far more capacity for the same length than the other. But it also, apparently, would help to increase the static in the phones.

The United States Government has evidently found some very excellent advantages in it tho, for it has adopted the barrel type for use on all its battleships, and has practically abandoned the use of the flat-top aërial on them. It was first tried out by our battleships that were working in conjunction with the Allied fleet in the North Sea.

No doubt the up-to-date Amateur will be glad to give these different antennae a try-out.



Hook-up of Special Variometer Coupler, Provided With Four Coils, Two in the Primary and Two in the Secondary.

NEW HONOR FOR SIR OLIVER J. LODGE.

On June 6th at Clarence House, the Duke of Connaught presented to Sir Oliver Lodge the Albert Medal of the Royal Society of Arts, which was awarded to the famous scientist "in recognition of his work as the pioneer of wireless telegraphy."

BARGAINS IN RADIO MASTS.

What with the great epidemic of underground antennæ now sweeping Amateur Radiodom, we should shortly see radio masts given away for the asking. What?

COMMERCIAL WIRELESS

Splendid opportunities now in the MERCHANT MARINE for Wireless Operators. Salaries now being paid—Junior Operators, $85 per month; Chief Operators, $110; food and quarters included. Equivalent ashore from $35 to $40 per week. Interesting and fascinating work. Our graduates in all parts of the world as operators, instructors, inspectors, etc., etc. Students from all over the country. If you are interested in Commercial Radio let the EASTERN RADIO INSTITUTE train you. Endorsed by Marconi and Government officials.

SUMMER COURSES. Day or evening start any Monday. Send for prospectus.

EASTERN RADIO INSTITUTE
899B Boylston St. Boston, Mass.

NEW catalog just off the press. Seventy-six pages of new apparatus for the Radio Experimenter. Send 4c for this complete catalog.

Haller, Cunningham Electric Co.,
478 Market Street, San Francisco, Cal.

THE BARR
MERCURY-CUP WIRELESS DETECTOR

The most efficient Detector on the market. Tested by the United States Government and Marconi Wireless Telegraph Co.

Increases the efficiency of every wireless receiving set by making the signals clear, sharp and distinct.

Instantly adjustable at a constant pressure. For full information and price—write

THE BARR MERCURY-CUP DETECTOR
169 Columbia Heights Brooklyn, N. Y.

TELEGRAPHY

Both wire and wireless, and Station Agency taught thoroughly and quickly, BIG WAGES NOW PAID, some of our recent graduates procuring $138.00 per month to start. Great opportunities for advancement. Our school the oldest and largest—annual enrollment 600 students. Endorsed by railway, telegraph, wireless and government officials. Expenses low—chance to earn part. Catalog free. Write.

DODGE INSTITUTE, 22nd St., Valparaiso, Ind.

New 1 K. W. Quenched Gap Transmitter

(*Continued from page 427*)

switch has been named a "Tone Clearer" because poorer tone conditions due to changed operation in the gaps may be compensated for by rotating the handle at the left of the holder as shown in Fig. 3. Precaution is urged never to use the power changer or gap changer with the current on, as the shaft and handle are "alive."

Each gap unit consists of two brass discs which are bolted together thru their centers. A silver ring electrode is riveted to one side of each disc. Two fish paper gaskets, one placed underneath the bolt head and the other between the interior face of the discs. Upon close scrutiny these gaskets will be observed in the gap in the photos herewith presented.

Proper cooling of the gap is afforded by the two sheet metal parallel flanges, which are placed integrally with each gap disc. These flanges join each other at two edges only, the other two edges being left open, forming a flue.

The resonance inductance which is furnished with this set is of the iron-clad type. It has two windings, one being for full power operation, the second, which is larger inductance, is for low-power operation. Actual operating tests show that the natural period of the A. C. armature, resonance, inductance and transformer primary is 425 cycles. The operating frequency ranges from 450 to 550 cycles.

One of the most unique parts of this set is the combination flame-proof Morse key and antenna switch. The key is made with larger contacts for carrying audio-frequency currents at low potential. It is encased in a gas-tight housing of black Japanned sheet brass, this housing making the "live" parts of the key free from all electrical contact with the power circuit. The connection between the key and the panel is made by two lengths of flexible cable, each five feet long. By means of the antenna switch, both the generator armature circuit and also the generator field circuit are broken when the switch is in receiving position.

The thermo ammeter is used in connection with the Weston shunt-block, one end being grounded to the panel frame. It reads from 0 to 15 amperes.

The wave changing device that is used in connection with this set, is built for durability as well as the highest efficiency. It consists of a fixt primary coil and movable secondary coil. They are designed to have corresponding turns as tuning points, and make simultaneous contact with two selector arms. At the left of the upper panel will be seen the handle which varies the wave length. At the left of this handle will be seen three openings, the center one being encircled by a white ring. The correct wave-length of the set is read from this point, the other two openings being for various calculations of wave length. The right-hand handle on the panel is used in connection with the loading inductance. Designated wave lengths of this set when operated on a Navy standard are 600, 752, 952 and 1,905 meters. This set under laboratory tests with a dummy antenna, the same as would be used on a ship, has radiated as high as 18 to 19 amperes antenna current. It has a daylight sending range from actual tests of over 1,000 miles.

This set is at the present time being used by the Navy and is installed on a great many of the merchant vessels, and has proven one of the most efficient sets ever designed.—*Photos courtesy, Emil J. Simon.*

Mechanical Engineering

Learn at Home!

Employers everywhere are looking for men with mechanical ability. Splendid salaries and rapid advancement are offered.

There is an easy, delightful way in which you can learn right at home in spare time. For 28 years the International Correspondence Schools have been giving men and women just the training they need for success in mechanical engineering and more than 200 other subjects. Hundreds of thousands have stepped into good positions through I. C. S. help, but never were opportunities so great as now.

Let the I. C. S. help *you*. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least and it will bring you information that will start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6199, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

ELECTRICAL ENGINEER	CHEMICAL ENGINEER
Electrician	SALESMANSHIP
Electric Wiring	ADVERTISING MAN
Electric Lighting	Window Trimmer
Electric Car Running	Show Card Writer
Heavy Electric Traction	Outdoor Sign Painter
Electrical Draftsman	RAILROADER
Electric Machine Designer	ILLUSTRATOR
Telegraph Expert	DESIGNER
Practical Telephony	BOOKKEEPER
MECHANICAL ENGINEER	Stenographer and Typist
Mechanical Draftsman	Cert. Pub. Accountant
Ship Draftsman	Traffic Management
Machine Shop Practice	Commercial Law
Toolmaker	GOOD ENGLISH
Gas Engineer	STATIONARY ENGINEER
CIVIL ENGINEER	CIVIL SERVICE
Surveying and Mapping	Railway Mail Clerk
MINE FOREM'N OR ENG'R	Textile Overseer or Supt.
ARCHITECT	AGRICULTURE
Architectural Draftsman	Navigator / Spanish
PLUMBING AND HEATING	Poultry Raising / French
Sheet Metal Worker	Automobiles / Italian

Name_____

Present Occupation_____

Street and No._____

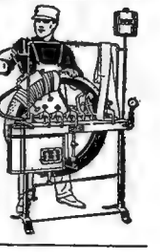
City_____ State_____

AN EASY WAY TO MAKE MONEY

Don't be content to plod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made $60.00 the first day." Others average $200 to $500 a month. Very little capital needed. Jobs plentiful. Every motorist a possible customer. No experience needed. We teach you.

SHALER Tire Repair Outfit

Improved Wrapped Tread Method Used by Tire Manufacturers



Does as good work as the big high priced vulcanizing outfits. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or regulating.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.
2208 Fourth St. Waupun, Wisconsin

BURGESS ENGINEERING COMPANY

Consulting Electrical Engineering

We design and perfect electrical devices and apparatus. Power plants, electric railway maintenance and operation, and railway signals a specialty.

Information supplied on electrical subjects

Write us your needs and permit us to advise you and furnish data. Our service is **prompt, reliable** and **satisfactory,** facts which are proven before our bills rendered are payable.

BURGESS BLUE BOOK

Our Mr. Burgess has prepared a pocket-size note book which is especially adapted for use by electrical men and electrical students. It contains over **two hundred formulas** for calculations and worked out problems, showing how the formulas are used. Also **drawings** of electrical machinery and **devices,** particular effort being made in regard to **Inside Connections.** This book is recommended by electrical men all over the country, is being used in several technical schools, and is being purchased by a number of electrical establishments who furnish them to their employees and customers.

The price of the Burgess Blue Book is $1.00 and we refund the price if the book does not meet with your approval.

BURGESS ENGINEERING CO.
Yorke Burgess, Pres. and Consulting Engineer
750 E. 42nd Street Chicago, Illinois

ELECTRICITY

Taught by a practical man.
Put part of your spare time to a good purpose.
A Home Study course for ambitious men.

This is a course of study for the worker, not the idler, and one who wishes to learn the electrical business, or to make quicker and surer progress in this line, I can help. The work as designed, suits both experienced men and beginners as the instruction is actually handled by me with a view of meeting the particular needs of each student. The principal requirement for success in my work is for the student to be willing and anxious to do his part, I do mine and I naturally expect and do insist that the students do theirs.

I Promise Little But Do Much

I only make one promise and that is to satisfy you if you are in earnest and will do your share. I cannot do it all alone for without some effort on your part, my instructions are useless to you. My course of study is not hard and one with an ordinary education can handle it successfully, as I have made every effort to reduce the subject to the simplest possible terms.

RESULTS

Practical men recommend my course to others. Over 65% of my students are engaged in electrical work. Over 11% of my present enrollment was obtained through satisfied students.

FIFTY-FIFTY

All my dealings are on a 50-50 basis. I look at the proposition from your viewpoint as well as mine, and do not expect you to do anything which I would not want to do myself, if I was in your position. While I naturally expect to make money through my efforts, at the same time, MONEY is not my first thought. No student is permitted to pay cash for his course on starting, the payment being made in monthly installments. Also students have the privilege of discontinuing the work if they find it is not just what they wish, and their payments stop at the same time.

Send for my catalogue which tells the whole story regarding the way in which the instruction work is handled, terms and what I have done for others.

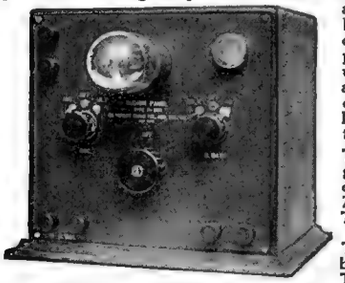
Yorke Burgess, Supt.,

BURGESS ELECTRICAL SCHOOL 745 E. 42nd Street, Chicago, Illinois

AMAZING AUDION DETECTOR VALUES-$9.50 $11.75 $18.85 $22.00

Remarkably efficient and handsome audion control panels within the price limit of **EVERY AMATEUR, BUILT AND DESIGNED FOR THE AUDION, AS ONLY THE MAKERS OF THE AUDION CAN BUILD IT.** IN THE PAST, INSTRUMENTS OF THIS CALIBRE HAVE NEVER BEEN OFFERED AT TWICE THESE PRICES.

GENERAL SPECIFICATIONS, ALL MODELS: Beautifully engraved and grained genuine bakelite panels; 4 prong heavy nickeled tube receptacles; smooth running, positive acting, adjustable rheostats; impregnated efficient mica stopping condensers; adjustable or fixed grid leaks with polished nickel covers; bakelite covered binding posts with new slotted positive connecting feature; positive segmentally connected nickel plated switches; 40 volt B battery of two 20 volt type units cast en block with operating life of 6 to 12 months—a remarkable advance in B batteries; handsome quartered oak cabinets, round corners, standard de Forest "Early English" finish; perfect workmanship and expensive design throughout.



TYPE P500—$22.00

Type P-400 Audion Panel—Consists of tube receptacle, grid leak and condenser, rheostat and binding post for connection to tuner, A and B batteries on bakelite panel 7½" x 7½" without cabinet and B batteries.....$9.50
Type P-401 Audion Panel—Same as above with cabinet, $11.75
Type P-402 Audion Panel—Larger panel with 40 volt B battery in cabinet.....$18.85
Type P-500 Audion-Ultraudion Panel—Type P-402, Panel with two switches for audion-ultraudion connection and either 20 or 40 volt B battery in cabinet.....$22.00

TYPE P401—$11.75

NOTE: All de Forest audion apparatus is sold without the tubes. Audion detector oscillator or amplifier tubes, $7.00 each additional. Catalog sent on receipt of 10c in stamps to cover postage.

DE FOREST RADIO TEL. & TEL. CO., 1415 Sedgwick Avenue, New York City

Developing An Idea

By Nelson Hall

(*Continued from page* 456)

much, gathers up a large amount of information in his travels which he is ready to impart to any one who will give him an attentive ear. By pulling him to your line you can get what he knows and all he has heard. In time he will make a good advertising medium if he is given "the dope."

Then one can inquire in stores handling such a line for the article. They will show the nearest thing in stock and tell if they have seen anything like it. Also it is good to write to mail order houses, for they are posted on a large variety of manufactured commodities.

Trade journals and magazines have special articles describing new inventions as they come out and later advertise them. One can find these articles by consulting such as *Pool's Index, Reader's Guide to Periodical Literature* and *The Industrial Arts Index,* which can be found in public libraries. Often librarians will look up references and sort out the articles if you will write or telephone your request in time. But usually it is best for one to go over the references himself, for while the articles may not directly pertain to the subject they may suggest something worth while considering. Strange as it may seem, the best part of some papers is in the advertising section. By taking papers going to the class of people interested in your article you can see what is being offered. It is well to look over several different papers, because advertisers do not confine themselves very closely and often try the dailies as well as trade journals. A good paper for general interest is the *Saturday Evening Post;* for office supplies, *System;* for household supplies, *The Ladies Home Companion;* for agricultural implements, *The Farm Journal* or *The Country Gentleman;* for tools, *Machinery;* for marine supplies, *The Marine Engineer;* for power plant equipment, *The Electrical World,* and the ELECTRICAL EXPERIMENTER, for what the electrical experimenter and "bug" will want. Nearly every public library has all of these and many more along the same lines on its files. But if one desires most of them can be obtained from newsstands.

From the advertisers many circulars, catalogs and leaflets can be had for the asking. In some libraries there is a file of trade catalogs in the industrial department that may be profitably consulted.

Sometimes going to all of this trouble will not bring to light the fact that some one has taken out a patent on this very article and has not put it on the market—yet. Hence it behooves one to make a patent search or have one made. Patent attorneys will make the search from a drawing, model, or description if it is clear to them, for a nominal fee. But it is usually more satisfactory for one to make the search himself; then he can see what has been done and the looking about may suggest something new. The *Patent Office Gazette* is on file in public libraries and in offices of many patent attorneys. One can go thru the indexes of these, get the numbers and read the short description given in the Gazette, and if it interests him send for a copy of the original patent. These can be obtained from the Commissioner of Patents, Washington, D. C., for five cents each in coin or money order (no stamps accepted). If one decides to have the search made, be very certain that the attorney has the idea right, understands how it works, and sees the novelty of it. He should be furnished with an assembly drawing, lettered so it can be described, clearly showing how it works, and laying special stress on the novelty. A copy of the one taken to the notary public is all right.

Some may think this is carrying the research too far, but after an inventor has developed an idea or two with much laborious study and a fair amount of money on experimental work he will then realize the importance of looking ahead and finding out what has been done by other inventors *and not do the same thing over.* Looking ahead will save the inventor much annoyance and his company from financial distress. Many Teslas and Edisons are turned into insignificant positions because they blundered in their first attempt and lost heart.

The Mystery of Atmospheric Electricity

By Rogers D. Rusk, M. A.

(*Continued from page* 416)

particles the water vapor has condensed as a liquid, forming the large ions, while about others it has only condensed as a dense atmosphere, forming the intermediate ions. When the vapor pressure in the air increases, the dense atmosphere on the intermediate ions may change to a liquid, as in Fig. II, and thus the *intermediate* ions become *large* ions in a fraction of time. This theory is not at all conclusive but it fits in with the observed facts better than any other, and is the only one which explains how the intermediate ions may suddenly become larger and more slowly moving. As water vapor only condenses in this peculiar way on rigid surfaces under certain conditions, we must assume that the centers of the intermediate and larger ions are different from the smaller ones usually found in gases and that they contain some small, rigid dust-like particle. This would also explain why they are not found in dust-free gases even tho the small ions are present, and why they are commonly found in the air.

HOW ATMOSPHERIC PARTICLES ARE ELECTRIFIED.

How these particles become *electrified* is another and vital question. There are many possible ways in which the phenomena may be accounted for. The ultra-violet light from the sun is a very powerful ionizing agent, having the power to detach electrons from the molecules of the air, as it passes thru the air. This ultra-violet light is particularly strong in the upper and thinner layers of the atmosphere, and tho the air absorbs a great many of these waves on account of their shortness, still a large number reach the lower levels of the air. Some more visionary theorists claim that ions and electrified particles are actually carried in huge streams from the sun to the earth, and there is some striking evidence that this may be true during periods of the sun's greatest activity. Friction is a great producer of electric charges, as is evidenced by the action of the well known friction *static machine,* and it is highly probable that friction of the air and dust particles in the air may be one of the potent causes of the electrification of the air. Again it may be due in part to radio-active substances in the earth's surface which constantly give off electrified particles into the air.

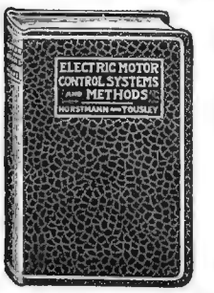
The mystery of the electricity in the air is a double one and if we could discover just how the ions are produced we could more easily ascertain just what they consist of. When these two questions are solved we may be in a position to harness the "electricity of the air" to our own use.

Fit Yourself for the Big Job

Don't hesitate any longer. There is a greater demand for trained men now than ever before — greater opportunities — bigger pay — more rapid advancement. It's training that counts now—accurate knowledge—a complete grasp of your trade.

Drake's Practical Mechanics Books

For Home Study



Pave the way to the fat pay envelope. Written in non-technical language that any man can grasp. Send the price of any book listed below. We will send the books postpaid — you keep them five days—if not entirely satisfied return the books and your money will be refunded in full. Order direct from this page. Use the Coupon.

Electrical Books

Electric Motor Control Systems and Methods. Leatherette.....$1.50
Electrical Tables and Engineering Data. Leatherette 1.50
Motion Picture Operation. Leatherette.. 1.50
Alternating Current. Leatherette..... 1.50
Wiring Diagrams and Descriptions. Leatherette 1.50
Armature and Magnet Winding. Leatherette 1.50
Modern Electric Illumination. Leatherette 1.50
Modern Electrical Construction. Leatherette 1.50
Electricians' Operating and Testing Manual. Leatherette..... 1.50
Drake's Electrical Dictionary. Leatherette 1.50
Electric Motors, D and A. Leatherette.. 1.50
Electrical Measurements and Meter Testing. Leatherette..... 1.50
Drake's Telephone Handbook. Leatherette 1.50
Elementary Electricity. Cloth..... 1.25
Electricity Made Simple. Cloth..... 1.00
Easy Electrical Experiments. Cloth..... 1.00
Operators' Wireless Telegraphy and Telephone Handbook. Cloth..... 1.00
Telegraphy Self Taught. Cloth..... 1.00

Automobile Books

Automobile Ignition. Leatherette, $2.00
Brookes' Automobile Handbook. Leatherette ..$2.00
Automobile Starting and Lighting. Leatherette ..$1.50
Ford Motor Car, Truck and Tractor Attachments. Cloth, $1.00
Storage Batteries. Cloth .....$.50
Ford Motor Car, Truck and Tractor Attachments. Leatherette ..$1.50
Automobile Catechism and Repair Manual. Leatherette $1.25
Gas and Oil Engine Handbook. Cloth... 1.00
Gas and Oil Engine Handbook. Leatherette 1.50
The Up-to-Date Electro-Plating Handbook. Cloth $1.00
Sheet Metal Workers' Manual. Leatherette 2.00
Oxy-Acetylene Welding & Cutting. Cloth 1.00
Brookes' 20th Century Machine Shop Practice. Cloth 1.00
Brookes' 20th Century Machine Shop Practice. Leatherette 1.50
Practical Mechanical Drawing & Machine Design. Cloth 2.00

Mail the Coupon NOW

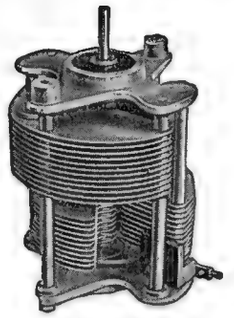
Order on our five day money back plan.

FREDERICK J. DRAKE & CO.,
1009 Michigan Ave., Chicago, Ill.

Enclosed find ($.....), for which please send me prepaid the books checked in this adv. (or list attached). It is agreed that I may return same in 5 days if not entirely satisfied, and money will be refunded in full.

Name .....

Address .....



Type 800

Balanced Variable Cond. Supplied in three sizes. Unmounted or mounted in nickeled brass case for use with oil or other liquid dielectrics

Radio Electrical Apparatus

Our new Bulletin Y offers a distinctive line of Radio and Laboratory apparatus including Transformers, Spark Gaps, Oscillation Transformers, Variometers, Variable Condensers, etc., in fact, the most complete line built by any single manufacturer in America.

Bulletin R describes the Cambridge alternating Current Rectifier for

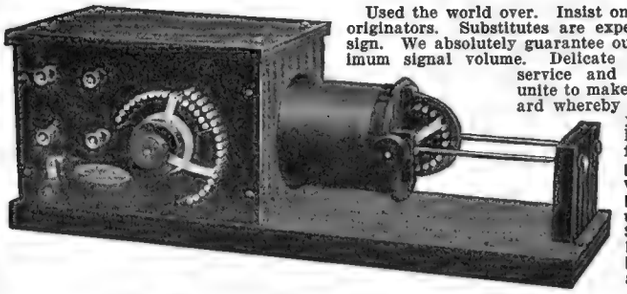
STORAGE BATTERY CHARGING

Send 3c stamp for both bulletins

CLAPP-EASTHAM CO.
131 Main Street Cambridge, Mass.

REMLER RADIO MFG. CO.
62 Post Street - San Francisco
Pacific Coast Representatives

TRACO QUALITY
RECEIVING TRANSFORMERS



Used the world over. Insist on the genuine, built by its originators. Substitutes are expensive, irrespective of design. We absolutely guarantee our tuners to give the maximum signal volume. Delicate refinement, uninterrupted service and high class workmanship unite to make TRACO tuners the standard whereby all others are judged. If your Dealer does not handle them, order direct from us.

LIBERTY DETECTOR VALVES. RADIO AMPLIFYING PHONES, type used by the UNITED STATES, BRITISH and FRENCH GOVERNMENTS, now in stock, for sale.

Send stamps for bulletins.

The Famous 5A and 5C Models

THE RADIO APPARATUS CO., Pottstown, Penna., U. S. A.

SPECIAL SALE!

$1.00 ONLY

Postage extra.

Ship. Weight, 2 lbs.

Diameter, 3¼ ins.

Reduced Photograph of Transmitter showing nickel plated case and Hard Rubber Mouthpiece

We have on hand 2,000 Carbon Grain Transmitters as per photograph. They are first-class instruments and may be used for all kind of experiments, especially for **wireless telephone sets,** where a heavy current is to be passed through. Slightly used, but in perfect working order. Money refunded if not satisfied. A real bargain. Order one or more today.

THE ELECTRO IMPORTING CO., 231 Fulton St., NEW YORK

You Need These Remarkable Books

No. 5. Wireless Construction and Installation for Beginners
Describes in detail with *working drawings* how any handy boy can make his own apparatus at lowest possible cost. Describes simpler and cheaper apparatus than No. 6 Book. 73 pages—67 illustrations.

No. 6. Experimental Wireless Construction
Explains in detail with *working drawings* how to build wireless apparatus, how to erect the aerial, connect and operate. 86 pages—93 illustrations.

No. 3. Lessons in Wireless Telegraphy
Explains in detail the principles and apparatus for wireless from aerials to end losses and Audions.

Price, 25 cents each, Postpaid, Anywhere

COLE & MORGAN, Inc., *Publishers,* P. O. Box 473 C. H. Sta., New York City

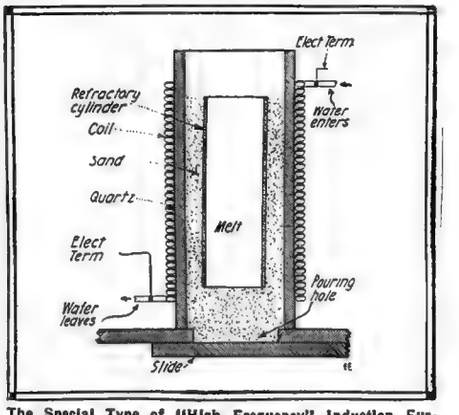
Possibilities of High Frequency Currents

(*Continued from page* 410)

could hardly be called power transmission, for only a very small portion of the original energy eventually reaches its destination in any case.

Very few investigators have given any thought to the utilization of these currents, for great power distribution.

Very new and strange phenomena are apparent when these currents are working. For instance, currents can be induced efficiently in circuits *without iron* as a magnetic medicine. Hysteresis losses are practically eliminated. Without iron in a transformer, it would be lighter for a given power than the present 60 cycle ones. It would be more compact, thereby reducing magnetic leakage. There is no saturation point to consider because of an air core. The reactive effect of a few turns of wire



The Special Type of "High Frequency" Induction Furnace Required for Enabling the "Carbon Free" Melts is Here Illustrated. The Tremendous Concentration of Energy Produced by Inductive Action in a Comparatively Small Volume Makes It Necessary to Maintain the Inductor Coil Cool by Artificial Means. To Accomplish This Cooling in a Simple and Effective Manner, the Material Used for Winding the Inductor Coil is a Thin Walled Flattened Copper Tubing. It is Flattened and Wound Edgewise to Obtain the Maximum Possible Number of Turns to the Inch. A Small Flow of Water Thru This Tubular Coil Maintains it Always at the Temperature of the Tap Water Used. The Melt, Which is Located Within the Inductor Coil and Which May be Only ½ to 1 Inch Less in Diameter than the Inside diameter of the Coil, May be Raised to a Temperature of 2500° or 2800° C., the Coil Remaining Under 20° C.

is very great; but a small condenser will cause resonance. Therefore the power factor can be easily made unity.

Among the few original engineers in this field of high frequency A. C. power transmission is Prof. Dr. E. F. Northrup, who was assisted by the writer at the Palmer Physical Laboratory, Princeton University, in extensive research along these lines. With these currents, it was possible to get results never before obtained by any other investigator.

Advantages of High Frequency Transformers

With an *air core* transformer, having a resistance load, more efficient results were noticed than could be procured with transformers having iron for a core. The losses were mostly due to the resistance of the conductors; but they were very small, as the circuits were of large cross-section. The hysteresis was negligible, due to the absence of iron. Magnetic leakage was reduced to a minimum because the coupling between primary and secondary was close. The capacity was 10 kilowatts, with three turns primary, insulated for 7,200 volts, and one turn secondary, reducing to 2,400 volts. The circuit was *resonant; therefore the power factor was unity,* or numerically 1.

It remained for Prof. E. F. Northrup to critically study these currents at *low voltage.* He found they could be confined in a mass of metal, thereby producing a terrific heat in a very simple and efficient manner.

"The Livest Catalog in America"

Our big, new electrical cyclopedia No. 20 is waiting for you. Positively the most complete Wireless and electrical catalog in print today. 180 Big Pages, 500 illustrations, 300 instruments and apparatus, etc. Big "Treatise on Wireless Telegraphy." 20 FREE coupons for our 160-page FREE Wireless Course in 20 lessons. FREE Cyclopedia No. 20 measures 7x5¼". Weight ½ lb. Beautiful stiff covers.

WIRELESS

Send 6 cents in stamps or coin for which we will send our latest Cyclopedia Catalog No. 20 as described.

ELECTRO IMPORTING COMPANY
231 Fulton St., New York City

MICA DIAPHRAGM TELEPHONES

We carry a complete stock of Baldwin Mica Diaphragm Telephones, both the old and new types.

Old type (type C).....$23.00
New type (type E)..... 26.00
(postage on two pounds extra)
High grade galena crystals 20c oz.

Send for circulars and price lists

PACIFIC RADIO APPARATUS COMPANY
1247 Forty-seventh Avenue
San Francisco California

AMATEURS! DO NOT OPEN TRANSMITTING STATIONS
without first learning to send and receive radio MSGS.
WILGO WIRELESS PRACTICE SET

The first need of every amateur. Hightone buzzer and key for learning code. Also for test buzzer and four other purposes. With code, wiring diagrams and instructions.

$1.00 Postage Extra

Our new cat. "E" of electrical and wireless apparatus and code chart sent for 3c stamp.

THE WILCOX LABORATORIES LANSING MICHIGAN

WIRELESS

On account of increased demand for Radio Operators, we have concluded to give a correspondence course aside from our regular day and night classes. Full course $20, with FREE learning instruments.
Write for Literature, SOUTHERN WIRELESS INSTITUTE, 22 St. Paul St., Baltimore, Maryland.

WIRELESS apparatus, Raw Materials, Magnet wires, motors, experimenters' needs, novelties listed in our Catalogue C-3. Assure yourself of prompt service and right prices by buying from this world famed, reliable, experimenters' Supply House.

The Newman-Stern Co., Cleveland, O.

RECO QUALITY

SUPERLATIVE RADIO EQUIPMENT
THE BEST KEY IN THE COUNTRY
10 Amp. $7.75—20 Amp. $8.25
A three cent stamp will bring bulletins of this and other higher grade apparatus. Audiotron, double filament detector, amplifier, oscillator, $5.00.
THE RADIO ENGINEERING COMPANY,
22 St. Paul St., Baltimore, Md.

GET ONE!
Make your station more selective and efficient for only $10.50. Send 2-cent stamp for bulletin.
COLBY'S TELEGRAPH SCHOOL, AUBURN, N.Y.

Actual Size

AMERICAN ELECTRO TECHNICAL APPL. CO.
235 Fulton St., N. Y. City Cort. 3153
Batteries,-special type for Audions
Switch Points—Binding Posts, Knobs —Levers—Rods—Sliders, Etc.
All parts for the Amateur to make his own Apparatus.

The present day development in wireless has been to *raise* the voltage and frequency, because under these conditions maximum radiation of energy is brought about.

After several years of careful experimentation, a *high frequency, electric induction furnace* was produced that was applicable for the production of heat in either a *conductor* or *non-conductor*. Its extreme simplicity, owing to the absence of iron and a few turns in the inductor coil, leads one to believe that along these lines lay perfection in electrical mechanics.

At present there is in actual operation under industrial conditions a 20 K.W. furnace of this type. It is used for studying glass at high temperature in *vacuum or under pressure.*

A few years ago applications of this sort were purely imaginary.

There is now under test a 50 K.W. unit. Most all tests were carried on with the damped oscillations of condenser discharges up to 50 K.W., but the undamped oscillations of the high frequently alternator will be used for greater capacity.

With the spark method for producing these currents, a two phase field was used, no doubt for the first time. Altho nothing other than a half revolution of a circular conductor on an axis in this field was noticed, the writer is firmly convinced that, with proper apparatus and research, an induction motor could be made utilizing these currents. *A motor of this sort would be* WITHOUT IRON as a magnetic medium and therefore extremely light. Proper design would undoubtedly make it efficient.

High frequency lighting has already given promise to be eventually the means whereby the much heralded "cold light" may be produced.

The fundamental principles involved in producing these currents has been firmly establisht in "wireless" and with these methods, slightly changed, it is possible to investigate a brand new field of "endless wonders."

In the last decade there has been marvelous advances in electricity; but these have only paved the way for far greater things.—*Photos courtesy Pyrolectric Instrument Co.*

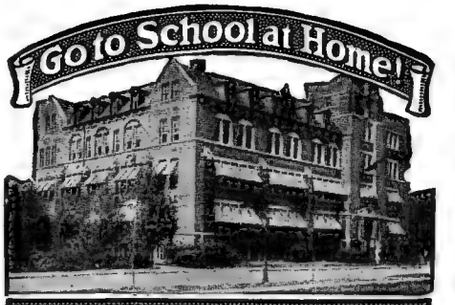
Practical Chemical Experiments

By Albert W. Wilsdon

(*Continued from page* 418)

soluble glass as it is called. Into most laundry soaps both sodium silicat and sodium carbonat are *crutched,* as a filler to soften hard water and to give additional detergent properties.

Toilet soap is made either by melting raw soap, by perfuming an odorless soap, after cutting in fine shavings and drying, or by making the soap directly by the use of pure materials. In either case the mass is colored by metallic oxids or anilin colors, and is perfumed by the use of essential oils, and is then prest into molds while yet fresh. To make a transparent soap it is necessary to dissolve an ordinary soap in alcohol, allow the insoluble residue to settle out, and distill the alcoholic solution to jelly. This may then be prest into molds and dried. Another method quite frequently utilized is to make a cold process soap, with coloring matter and perfume aded, and then to add to the mass more glycerin, or a strong sugar solution, which renders it still more transparent. Soft soap is made directly by the use of potash lye, or by the use of soda lye and considerable water. The glycerin and the excess of lye, if any, remain in the soft soap. This is used in *fulling* or shrinking cloth and in other manufacturing operations, probably on account of the excess of alkali which it contains. The salt lye which is drawn off



HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This Course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years.* You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

TAKE 10 LESSONS FREE So that you may see for yourself how thorough and complete our training is. We invite you to take *ten lessons* in the High School Course—or any Course of specialized training in the Coupon below—before deciding whether you wish to continue. If you are not then satisfied you are not out one cent. *We absolutely guarantee satisfaction.* On that basis you owe it to yourself to make this test. Check and mail the coupon NOW for full particulars and Free Bulletin.

AMERICAN SCHOOL OF CORRESPONDENCE
Dept. H 266 Chicago, Illinois

TRAINING—THE KEY TO SUCCESS

Please explain how I can qualify for the position marked X

.....High School Graduate	.....Lawyer
.....Electrical Engineer	.....Business Manager
.....Elec. Light & Power Supt.	.....Certified Pub. Accountant
...Hydroelectric Engineer	.....Accountant and Auditor
.....Telephone Engineer	.....Bookkeeper
.....Telegraph Engineer	.....Stenographer
.....Wireless Operator	.....Fire Insurance Expert
.....Architect	.....Sanitary Engineer
.....Building Contractor	.....Master Plumber
.....Civil Engineer	.....Heating and Vent. Engineer
.....Structural Engineer	.....Automobile Engineer
.....Mechanical Engineer	.....Automobile Repairman
.....Shop Superintendent	.....Airplane Mechanic
.....Steam Engineer	.....General Education Course
.....Draftsman and Designer	.....Common School Branches

Name.....

Address.....

Type L-1 Inductance Units

Pancake wound in Oak Cabinet with Bakelite front. Can be used as Loading Inductances or one can be used as a Primary and a second as a Secondary constituting an excellent long wave tuner, the range depending upon the size units employed. To vary the coupling it is only necessary to change the relative positions of the units. Also can be used with great success as Tickler Coils for Regenerative Reception. Furnished in three sizes.

Maximum wavelength obtainable, 5,000 meters $10.00
Maximum wavelength obtainable, 10,000 meters 11.00
Maximum wavelength obtainable, 15,000 meters 12.00

Shipping Weight 4 pounds.
Send stamps for complete catalog of high grade apparatus.

WESTERN RADIO LABORATORIES
156 Second Street
San Francisco, California.

Q. S. T.

"All men having commercial licenses should report for jobs at once."

Big shortage of operators!

Every student completing the course has qualified himself to fill a position paying $85-$130 per month and keep.

Short, thoro course — excellent laboratory.

Dormitory — swimming pool.

Call or write for illustrated booklet.

Y. M. C. A.

RADIO SCHOOL

NEW YORK CITY

Manhattan Branch: 154 East 86th St. Tel. Lenox 6051
Brooklyn Branch: Marcy Ave. Near B'way Tel. W'msburg 3800

NEW-ORLEANS
WIRELESS SUPPLIES AND MINERALS OF ALL DESCRIPTIONS
L. A. ROSE
4323 MAGNOLIA STREET
NEW ORLEANS, LA.

HERE IT IS

The sign that you have all wanted but could never get. Printed in bright red with big bold letters on stiff cardboard. Don't miss this opportunity to make your den or station look big and dangerous to others. This sign is exceedingly attractive and neat No electrical bug should be without one. 7¾" x 11½". Price 20c, 3 for 50c, pos paid anywhere.
LEONARD BECK, 102 Meridith Ave., Arverne, N. Y.

from the kettle in which soap is boiled is used for the manufacture of glycerin. In this process the soluble soap and impurities are taken out by chemical treatment, and mineral salts are separated by evaporation and crystallization. The purified crude residue containing about 80 per cent glycerin is distilled with steam under diminished pressure.

It is false economy to use a cheap soap, on account of the excess of alkali which it usually contains, it injures the fabrics washed, by causing the fibers to disintegrate and readily fall apart. There is a great advantage in using a well dried soap, as it does not so readily become soft in the water and therefore does not wash away so quickly. A laundry soap will lose 25 per cent of water if the bars are piled and allowed to remain for some time where they are freely exposed to the air. Chevreul in his researches on soap said that the cleaning action was because the soap was decomposed, when brought into contact with the water, into fatty acid and alkali. The impurities are set free by the alkali and entangled by the fat acid salts, and thus removed with the lather. Thus it will be seen that vigorous rubbing is not necessary to remove the dirt, tho, quite naturally, it aids the process.

Ordinary soaps are readily soluble in water, but if the water is *hard* from the presence of lime or similar mineral substances, the alkali soap is decomposed and an insoluble lime soap is precipitated, thereby forming a disagreeable scum on the water. Not until all this lime is thrown down by the soap will the lather begin to have a detergent action. On account of the necessity for using hard soap in some localities *washing soda* is used to *break* the water; that is to precipitat the lime so that less soap will be required. In order to make a laundry soap fit for hard water, sodium carbonat is added to it in the crutching.

Experiment No. 1. To make a hard soap, dissolve in a medium-sized beaker 15 grams of caustic soda (in stick form) in 120 cc. of water, and pour one-half of this into a porcelain evaporating dish of at least 500 cc. capacity, add 60 cc. of water and 50 grams of tallow. Boil this solution for three-quarters of an hour, carefully replacing, from time to time, the water that has been lost by evaporation; then add the remainder of the solution of caustic soda and boil for at least an hour more. Water should be added as before, but the volume of the liquid may be allowed to decrease about one-third. Add 20 grams of salt, boil for a few minutes, and allow the liquid to cool. The soap will rise to the top, and the glycerin, excess of lye, and salt will remain in solution.

Experiment No. 2. Slightly acidify the water solution separated from the soap in the above experiment with dilute hydrochloric acid. If any fatty acids or impurities separate out, filter. Pour the solution into a porcelain evaporating dish, and evaporate to dryness on a water bath. Dissolve the residue in strong alcohol, filter or decant from the undissolved crystals of salt, and evaporate the alcohol. The slight residue will be sticky, and give the sweet taste of glycerin.

Experiment No. 3. Cut a good quality of soap into shavings and mix with hot water on a water bath, until well dissolved. Add dilute sulfuric acid until the solution is acid. Note that if the soap is *filled*, the sodium carbonat will cause an effervescence on adding acid. Heat on the water bath for some time or boil slowly, and the fatty acid will separate, forming an oily layer on the top. When clear this may be separated from the water by pouring on a wet filter, and the sulfuric acid removed by washing on the filter with hot water.

Washing soda, is often used, not only to soften hard water, but as a stronger

Big field—unlimited possibilities—increasing demand for men with creative ideas. Our course develops ability and originality. Work intensely interesting.

EARN $25. TO $75. WEEKLY

You can do it if ambitious. Successful graduates everywhere. Our course covers every phase of work completely and thoroughly. Our graduates command big salaries. Write for catalog, samples, guarantee and Free Outfit Offer.

DETROIT SCHOOL OF LETTERING, 689 B. S. L. Bldg. Detroit, Mich.

$3 AND $4 a month WILL BUY
A Beautifully Reconstructed
TYPEWRITER
With Every Modern Writing Convenience

WRITE TODAY FOR ILLUSTRATED CIRCULAR Explaining Try-Before-You-Buy Plan

HARRY A. SMITH, 738-218 North Wells St., Chicago, Ill.

Fun, Magic and Mystery!

56 Feats in Magic, 250 New Jokes, 21 Puzzles, 1 Fortune Telling Tablet, 52 Money-Making Secrets, 15 Card Tricks, 71 Toasts, 58 Verses in Comic Poetry, 10 Funny Readings, 41 Epitaphs, and 11 Parlor Pastimes. You get all the above-mentioned and our big illustrated Catalog of 125 Magic Tricks for only 10 cents. Write today.

MYSTIC MFG. CO.,
909 Springwells Ave., Detroit, Mich.

EASIEST SHORTHAND

Learn in 5 evenings home study; then acquire speed with K. I. Shorthand. **Amazingly simple, easy.** Approved by experts. Write dictation, messages, etc., rapidly as spoken, after brief pleasant practice. Pave way—method for personal use; make notes at lectures, meetings; keep confidential diary. Big help in any profession or business; **add to your career.** Used in Army, Navy, courts, commercial schools; by public and private stenographers, teachers. Slight cost. K. I. Shorthand **—for busy people, including YOU. Proof Lessons.** Guarantee and Brochure with testimonials free, postpaid. Address:
KING INSTITUTE, EL 300, Station F, NEW YORK CITY

"Hang Your Own Lighting Fixtures"

One Light Bracket $1.05—4 Light Shower $6.15 Semi-Bowls $5.85—Plate & Ball 85c, complete with glassware, Wired, Fine finishes. Send for Photos complete line.

ERIE FIXTURE SUPPLY CO.
Sta. C., Erie, Pa.

Small Capital Starts You

on our easy payment plan. Begin now and get your share. We sell everything. Write today.

Atlas Moving Picture Co.
Dept. 50 538 S. Dearborn St., Chicago

Chicago Medical School

fully accredited offers
DAY AND EVENING COURSES
leading to the Degree of Doctor of Medicine and Surgery. Exceptional opportunities for making way through school. Regular session begins Oct. 6. Matriculate at once. For full information and catalog, address **REGISTRAR**
3832 RHODES AVE. Box 18 CHICAGO

Electrical Experimenter
BOUND VOLUME No. 6

contains twelve numbers of the "Electrical Experimenter" magazine—May, 1918, to April, 1919, inclusive. There are 984 pages, 2,110 complete articles, 1,908 illustrations, 369 questions and answers. Size, 12" high; 9" wide; 2" thick.

$3.00 add postage for 8 lbs.

Positively the Greatest Electrical Book bargain in the World. We ship AT ONCE. Order today to avoid delay.

EXPERIMENTER PUBLISHING COMPANY, Inc.
Book Department
233 Fulton Street - New York, N. Y.

WE HAVE STILL SOME VOLUMES NO. 5 (1917—1918) LEFT, WHICH WE WILL SHIP AT THE SAME PRICE $3 AS LONG AS THEY LAST.
(ADD POSTAGE FOR 8 LBS.)

A NEW AND EASY WAY TO PAINT
SIGNS and SHOW CARDS
OUR PATTERNS DO THE WORK
No experience required. Anyone can paint all kinds of signs, banners, cards, etc., on any surface with our new and easy system of lettering. Complete outfit containing eight alphabets of letters, assorted styles and sizes from two to twelve inches high, also four sets of figures, etc., not printed but life size patterns cut out of durable tag board which can be used over and over again for years, also brushes, colors and book of instructions. Satisfaction guaranteed. PREPAID $7.50
ACME SALES CO., Empire Bldg., Denver, Colo.

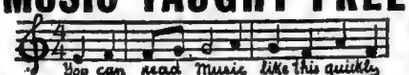
Red or Black "Vulcan" Ink Pencils
Two Sizes—4¼ and 5½ inches. Extra Size—8 inches (black only) $1.75. Your name in gold inlay—$ 35. FREE—Liberal supply of ink with retail orders. *A penis wanted. Big profits.*
The ONLY perfect, non-leakable ink pencils at moderate prices Order today. $1.50
J. R. ULLRICH & CO., 27 Thames St. New York

MATHEMATICS MADE EASY
The Arcascope—the Combination Triangle with a Brain—will multiply, divide, figure percentage and proportion, solve all problems in trigonometry and geometry, draw symmetrical figures, plot arcs, etc. Superior to any slide rule. Simple to operate. Also includes a TRANSPARENT TRIANGLE, PROTRACTOR and THREE RULES. Used at Columbia University, West Point, U. S. Aeronautic Schools, etc. Only 85 cents Postpaid. Order today before you forget.
Dept. J. L. J. LEISHMAN CO., Ogden, Utah

UMAKEM
Airplane Workchest, containing aircraft work table with mitre cutting board and length gauge, steel drill, steel hammer, Model Maker's steel square, screwdriver, sandpaper block, 10" scroll saw, together with finest quality reed and bass wood, aluminum, silk, para rubber, full set of blueprints, directions, and all fittings for building one 36" Bleriot Model flying Monoplane. Price $10.00. Other UmakeM Outfits 50c to $50.
W. R. PRICE, Inc.
No. 2 UmakeM Building, 127 Fifth Avenue, New York

How to Get Rid of Moles

A simple, safe home treatment—15 years' success in my practice. Moles (also BIG growths) Dry Up.
Ask for Free Booklet of Full Particulars
WM. DAVIS, M.D.
4140 State Street Perth Amboy, N.J.

MUSIC TAUGHT FREE

You can read Music like this quickly
In Your Home. Write today for our booklet. It tells how to learn to play Piano, Organ, Violin, Mandolin, Guitar, Banjo, etc. Beginners or advanced pupils.
American School of Music, 57 Lakeside Bldg., Chicago

CLEARTONE PHONOGRAPHS
$4.00 to $200.00 Retail

Needles 45c per thousand in lots of 500,000 Motors $1.35 to $14.75 each. Tone Arms and Reproducers $1.30 to $5.75 per set. Main Springs 20c to 90c each. Records, Needles, Sapphire Points and Parts at reasonable prices.
Write for our 84 page catalogue, the only one of its kind in America, illustrating 33 different styles of Talking Machines and over 500 different Phonographic Parts.
LUCKY 13 PHONOGRAPH COMPANY
Export Dept. 46B E. 12th St., N. Y., U.S.A.

WOULD YOU KNOW WHAT TO DO?
TO HAVE YOUR WISHES COME TRUE?
TO BE HAPPY AND SUCCESSFUL?
TO FEEL THE THRILL OF NEW POWERS?
TO HAVE A WINNING PERSONALITY?
Our system of Personal Development has shown thousands. It can show YOU. First lesson in SUCCESS, and your Personality Sketch for 10c and birthdate.
THOMSON-HEYWOOD CO.
Dept. 350, Chronicle Bldg., San Francisco, Cal.

Be an Artist
Comics, Cartoons, Commercial, Newspaper and Magazine illustrating. Pastel, Crayon portraits. Poster and Fashions. Earn Big Money. *Taught by Mail or* Local Classes. Write for illustrated booklet, terms and list of successful pupils
ASSOCIATED ART STUDIOS, 13A Flatiron Bldg., N. Y.

"BOW LEGS and KNOCK-KNEES" UNSIGHTLY
Send for booklet showing photos of men with and without THE PERFECT LEG FORMS.
PERFECT SALES CO.
140 N Mayfield Ave., Dept. 50 Chicago, Ill.

Be FREE From STAMMERING
Home Exercise Course. Results GUARANTEED or NO PAY. Write for full particulars.
Sutherland Course, Educational Bldg., 70-5th Ave., N. Y.

washing agent than soap. This is a much better material than most of the so-called *washing powders* on the market. It should always be dissolved in a bottle or other vessel, and used as a solution in the quantities necessary. An excess disintegrates the fabrics, or *rots* the goods. Sometimes the washing powders or liquids on the market contain in addition to the washing soda, a little soap or ammonium carbonat or a small per cent of borax, but they are much more expensive than the common washing soda, and no more efficient.

Experiment No. 4. To test a washing powder for sodium carbonat, put a little of it in a test tube and add a few drops of hydrochloric acid. If there is a brisk effervescence it will indicate the presence of a carbonat, and if the gas that is given off colors the Bunsen burner flame yellow, it is an indication of the presence of sodium.

Bluing.

Bluing is the process resorted to in the laundry to overcome the slight yellow color of the clothes, and for the same purpose in the bleacheries where new goods are finished. Indigo was one of the substances most commonly used some years ago. It was known to the ancient Egyptians as a dye and to the Romans as a pigment. The method of using it for bluing, as it is insoluble in water, is to tie up a lump in a cloth, and when soaked in water the finely divided precipitat which is in suspension will give a blue color to the water, and to the clothes, which are to be immersed in it.

Prussian blue (Ferric Ferrocyanid) is also used for bluing. It is insoluble in water and in mineral acids, but is decomposed by alkalies and dissolved by oxalic acid. It is generally used as a solution or *liquid blue,* but this imparts to the goods a greenish-blue color. On account of the ease with which it is decomposed by the alkalies, there is danger that *iron rust* will be deposited on the goods if this form of blue is used.

Experiment No. 5. Make Prussian blue by the action of Ferric Chlorid upon potassium ferrocyanid in the presence of a few drops of hydrochloric acid. Treat this blue precipitat with an excess of sodium hydroxid, and heat to boiling. Notice the reddish brown precipitat of ferric hydrat.

Experiment No. 6. Make some Prussian blue as in the previous experiment, and add to the precipitat, in the test tube, a few crystals of oxalic acid, and warm the mixture. Notice the intense blue solution obtained (liquid Blue).

Ultramarin is an interesting artificial compound which is put upon the market in the shape of small *bluing balls.* It is similar to the native mineral called *Lapis Lazuli,* and is a double silicat of sodium and aluminum containing sulfur. Like indigo, it is insoluble in water and is simply held in suspension in the liquid. There is a difficulty in preventing the formation of blue spots and streaks with the solid blue. This blue is extensively used for coloring wall paper and for *bluing* white sugar.

Experiment No. 7. To show the presence of sulfur in ultramarin place a part of a bluing ball in water in a test tube, and add to it enough hydrochloric acid to make the solution acid. Notice the odor of escaping gas when the solution is warmed, and test it for hydrogen sulfid by holding above the mouth a piece of paper previously dipt in lead acetat solution. The paper will turn black on account of the formation of lead sulfid.

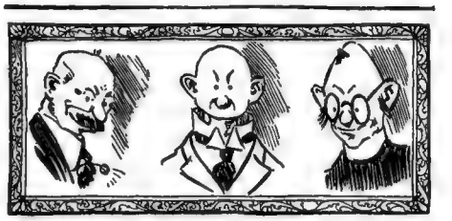
Anilin colors made from coal tar are the basis of most of the liquid blues upon the market at the present time. The soluble blues from this source are very numerous, and they are probably as satisfactory as anything for this purpose.

LEARN MUSIC AT HOME!
PLAY by NOTE
Piano Organ
Violin Cornet
Guitar Banjo
Mandolin Harp
'Cello Trombone
Flute Clarinet
Piccolo Saxophone
Ukulele Sight Singing
Music no longer difficult! New plan makes it easy to learn by home study. Positively easier than with private teacher. Faster progress. You will be able to play your favorite instrument in a few short months! More than 200,000 men, women and children have learned by our method. You, too, can learn in your spare time. We guarantee it.

H. S. Whittmack, New York, writes: "I compliment you on your wonderful system. Did not know one note from another, but in a short time have mastered the piano and am now composing music."

Louise Bowles, Epworth, Va., writes: "Received my teacher's certificate. I highly recommend your school and wouldn't take anything for the help it has given me."
Lessons FREE
We want to have one pupil in each locality at once to help advertise our home study method. For a short time, therefore, we offer our marvelous lessons *FREE.* Only charge is for postage and sheet music which is small. Beginners or advanced pupils. *Write* for amazing free book giving all the facts and particulars. Send a postal today!
U. S. SCHOOL OF MUSIC
1339 Brunswick Bldg., N.Y.C.

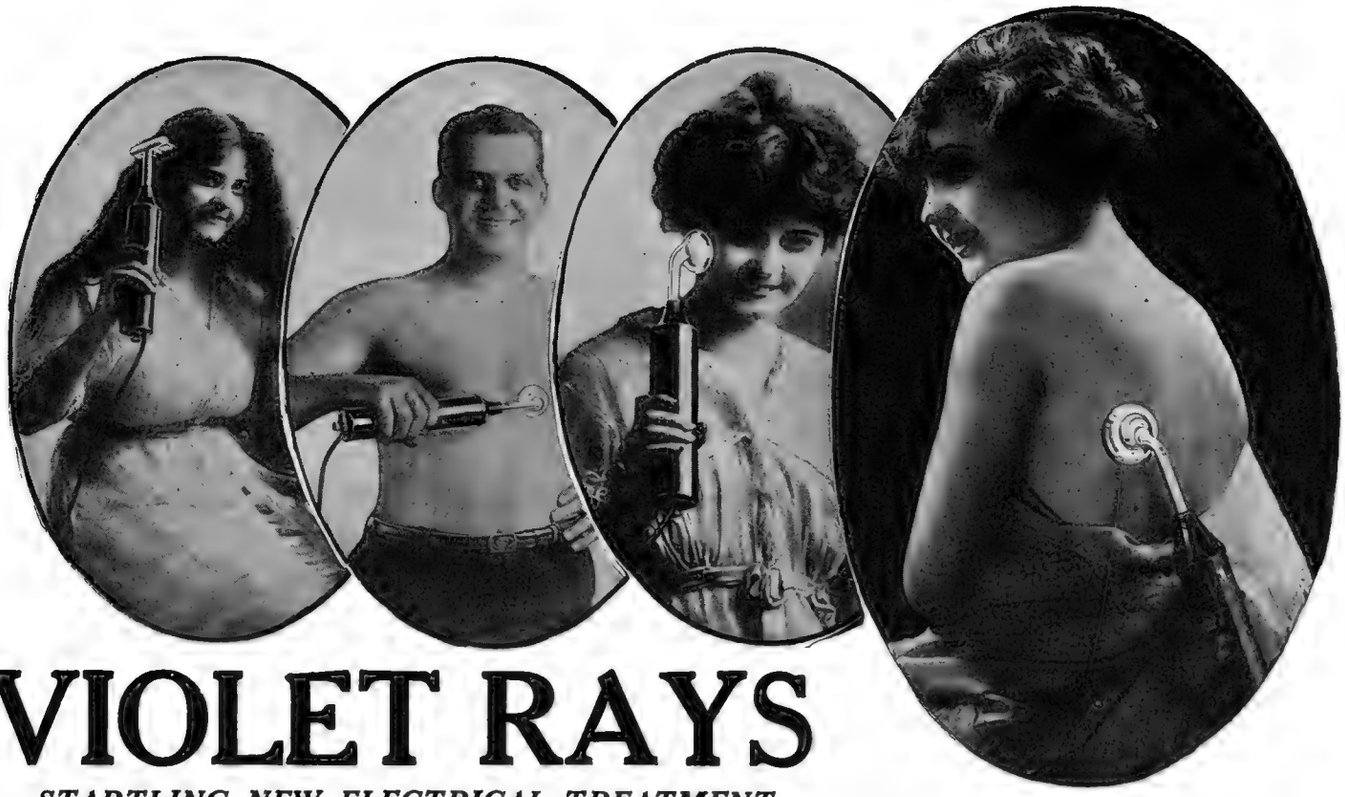
C. N. Pitts, Macon, Ga., writes: "Have completed your course on violin. Now have 15 students."


Learn to Draw at Home
Illustrators, Cartoonists, Commercial Artists earn big money. $25 to $100 a week and more. Learn at home in spare time under personal direction of Will H. Chandlee, famous newspaper, magazine, advertising artist of 35 years' successful experience.
BE AN ARTIST
Delightful, fascinating profession. Wonderful new home-study method makes drawing easy! Send coupon or postal today for special offer of complete Artist's Outfit FREE to new students. Write for handsome book, "How to Become an Artist." Don't delay—write or send coupon at once. Address
Washington School of Art, Inc.
1437 H. St., N. W.
Washington, D. C.
FREE COUPON
WASHINGTON SCHOOL OF ART, Inc.
1437 H St., N.W., Washington, D. C.
Send me particulars of FREE ARTIST'S OUTFIT offer and Free Book, "How to Become an Artist."
Name.....
Address.....
City.....State.....

Swing 4 in., 11 in. between centers, 17 in. total length. Shipping weight 13 lbs. Bed of lathe is machined. Workmanship first-class. Equipped with wood turning chuck. Can be fitted with 3 in. face plate and drill chuck as special equipment. Order one today. Price $5.00 cash with order. SYPHER MFG. CO., DEPT. C TOLEDO, OHIO

LEARN WATCH REPAIRING

You can learn by our modern and original system of instruction every part of the Watch Repairing Trade at home as good or better than at a shop. You can earn money while learning and secure a well paying position or start in business after completing our course of instruction. Good watch repairers are always in demand and earn from $20 to $35 per week. For particulars apply to the
Milwaukee School of Watchmaking 166 Mason St., Milwaukee, Wis.



VIOLET RAYS

STARTLING NEW ELECTRICAL TREATMENT

FOR HEALTH, ENERGY, BEAUTY

You can now try the wonderful new Violetta—Violet Ray Machine—10 days free in your own home. Give yourself daily treatments—at less than 1 cent per treatment. Rid yourself of headaches, catarrh, constipation, lumbago, insomnia, nervousness. Relieve your pain from neuritis, rheumatism, indigestion, neuralgia. Give yourself beauty treatments—remove eczema, pimples, blackheads, obesity. Make your body a human dynamo of energy and make your skin fine in texture and free from blemishes or sallowness. Double your strength, sharpen your appetite, soothe your nerves, beautify your complexion. Try Violetta 10 days free.

VIOLETTA—NOT A VIBRATOR

The Violetta does not shock or pain. It does not bind the muscles. It is not a vibrator. The Violetta soothes or stimulates, sending the magic healing power of electricity through every cell, tissue, and organ of the body. Electricity in its highest remedial form. Wonderful and painless even to infants. No other form of electricity for home use is so amazing in its results.

10 DAYS' FREE TRIAL IN YOUR OWN HOME

You can try the Violetta in your own home on our 10 days' trial plan. Not one cent do you have to pay if you are not pleased. Why suffer from physical ailments or from the handicap of a sallow, pimply, imperfect skin when you can try this wonderful treatment in your home without risk. The Violetta is used by thousands of physicians and drugless healers as well as by such prominent beauty specialists as E. Burnham, Chicago, Yvette Parlors in eighteen cities, and hundreds of others. Every penny you pay returned instantly if you are not pleased with the Violetta after 10 days' trial. Write for book describing Violetta Outfits and amazing results of Violet Ray treatments.

WRITE FOR BOOK FREE

Just send your name on a post card or use the coupon below for convenience. We want you to know what physicians, drugless healers, sanitariums, beauty specialists and individual owners say about Violet Ray treatments with the Violetta. We want you to know how it removes pain as if by magic—how it clarifies the skin almost over night—why it is painless, harmless, even to infants.

BLEADON-DUN CO. Dept. 2H.
326 West Madison Street, Chicago, Ill.

Please send me your free book and 10 days' trial offer on the Violetta Violet Ray Machine. This incurs no obligation on your part.

Name.....

Address.....

City.....State.....

MAIL COUPON OR POSTAL

We will tell you about our 10 days' trial plan and prove to you that no other machine ever made is in the Violetta class. The only self-contained Violet Ray Machine on the market. Sold direct to you or through your electrical dealer. Write today for free book and trial offer.

BLEADON-DUN COMPANY,
Dept. 2H.
326 West Madison St., Chicago, Ill.

Try the Violetta in Your Own Home For

Asthma	Earache	Obesity
Barbers' Itch	Eczema	Pains
Boils	Eye Disease	Paralysis
Blackheads	Falling Hair	Piles
Bunions	Hay Fever	Pimples
Callous	Headache	Pyorrhea
Catarrh	Goitre	Rheumatism
Chilblains	Insomnia	Skin Diseases
Colds	Lumbago	Sore Throat
Corns	Nervousness	Sprains
Constipation	Neuralgia	Tonsilitis
Dandruff	Neuritis	Whooping Cough
Deafness		

What Physicians and Users Say

Trixie Friganza, well known actress says "Cheerfully will I add my praise for Violetta. It's the best 'pain chaser' and 'soother' I've had the good fortune to find. It's WONDERFUL. It cured my brother of neuritis. As for myself I use it for facial treatments and general massage. I cannot say too much for it."

Dr. Bert H. Rice, of Vinton, Iowa, says: "I have good results with the Violetta High Frequency Instrument in all cases of neuralgia. Almost instant relief in Facial Neuralgia."

K. L. Allen, D.C., 205 Boone National Building, Boone, Iowa, says: "I have had very good results with the application of High Frequency Current in cases of Paralysis, Rheumatism and Neuritis, and think it a great help in drugless healing."

Dr. Daniels, Lisbon, North Dakota, says: "Have used the VIOLETTA in such cases as Goitre, Bronchitis, Pluerisy, Neuritis, Neuralgia and Lumbago, and find it very beneficial. In fact, I would not be without it in my office."

Experiments in Physics

By John J. Furia, A.M.

(*Continued from page* 417)

the card is turning thru 180 degrees the image remains if the speed of the card is sufficiently high. The image of the reverse side strikes the retina while the image of first side is still on it, and hence BOTH objects appear to be in view. This is the fundamental principle of the *motion picture.*

Figure (4) is another example of an illusion due to persistence of vision. A black star is drawn on a blank card. If the card is placed on the forefinger and spun around, the star will disappear and TWO circles will appear as in B, the inner one *black* and the outer one *gray.* As the card is spun around the image of the points of the star and the image of the white card between the points strike the eye in rapid succession, so that due to persistence of vision, both black and white are seen and the result is the gray circle or mixed shade. Since the center of the star is all black, the center circle is black.

Even tho money is not of much use to many of us now, the following interesting device for "Making Money" provides a fitting conclusion to any performance. A small miniature clothes wringer is brought forth. A piece of paper is cut to the size of a dollar bill. The paper is inserted in the wringer, *the handle is turned and a brand new, crisp dollar bill comes out from the other side!* This may be repeated indefinitely (provided the performer is a multi-millionaire). Figure (5) tells the secret. The two rollers are not two distinct rollers, but are made of a continuous piece of goods wound as in B. Beforehand the performer has wound some dollar bills into one of the rollers and then on performing the "stunt" places the paper in the other roller. *As he winds the paper into one roller, the dollar bill is unwound from the other roller.* If the apparatus is well made and carefully put together, a great deal of fun can be gotten from it without the *modus operandi* of the illusion being discovered.

(*To be continued*)

Presented to
Electrical Experimenter
In recognition of patriotic services for the United States during the period of its participation in the great war for Universal Democracy. The splendid morale of the people upon which rested the success of the Army and Navy, was in no small measure due to the co-operation of the advertising profession.
UNITED STATES GOVERNMENT
Committee on Public Information
Chairman
Secretary of State
Secretary of War
Secretary of the Navy
Carl Byoir
Associate Chairman

Diploma Awarded to the Electrical Experimenter by the United States Government To Show Its Appreciation of the Patriotic Service Rendered During the War by America's Greatest Electrical Magazine.

"I Can Succeed!"

"What other men have done with the help of the International Correspondence Schools, I can do. If the I. C. S. have raised the salaries of other men, they can raise mine. If they have helped others to advance, they can help me. To me, I. C. S. means 'I CAN SUCCEED.'"

Make up your mind right now that not another day shall pass until you have made *your* start toward success.

For 28 years men in offices, stores, shops, factories, mines, railroads—everywhere—have been winning promotion and increased salaries through the I. C. S. More than 100,000 men and women are getting ready *right now* with I. C. S. help for the bigger jobs ahead.

No matter where you live, the I. C. S. will come to you. No matter what your handicaps, or how small your means, we have a plan to meet your circumstances. No matter what career you may choose, some one of the 280 I. C. S. Courses will surely suit your needs.

When everything has been made easy for you—when one hour a day spent with the I. C. S. in the quiet of your own home will bring you a bigger income, more comforts, more pleasures, all that success means—can you let another single priceless hour of spare time go to waste? Make your start right now! This is all we ask: Without cost, without obligating yourself in any way, put it up to us to prove how we can help you. Just mark and mail this coupon.

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
BOX 6201, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

ELECTRICAL ENGINEER	SALESMANSHIP
Electric Lighting and Rys.	ADVERTISING
Electric Wiring	Window Trimmer
Telegraph Engineer	Show Card Writer
Telephone Work	Sign Painter
MECHANICAL ENGINEER	Railroad Trainman
Mechanical Draftsman	ILLUSTRATING
Machine Shop Practice	Cartooning
Toolmaker	BOOKKEEPER
Gas Engine Operating	Stenographer and Typist
CIVIL ENGINEER	Cert. Pub. Accountant
Surveying and Mapping	TRAFFIC MANAGER
MINE FOREMAN or ENG'R	Railway Accountant
STATIONARY ENGINEER	Commercial Law
Marine Engineer	GOOD ENGLISH
Ship Draftsman	Teacher
ARCHITECT	Common School Subjects
Contractor and Builder	Mathematics
Architectural Draftsman	CIVIL SERVICE
Concrete Builder	Railway Mail Clerk
Structural Engineer	AUTOMOBILE OPERATING
PLUMBING AND HEATING	Auto Repairing
Sheet Metal Worker	Navigation
Textile Overseer or Supt.	AGRICULTURE
CHEMIST	Poultry Raising
	Spanish
	French
	Italian

Name_____

Present Occupation_____

Street and No._____

City_____ State_____

E. I. Co.'s High Grade Radio-Instruments
FOR SCHOOLS AND LABORATORIES AT REASONABLE PRICES

No. 7710

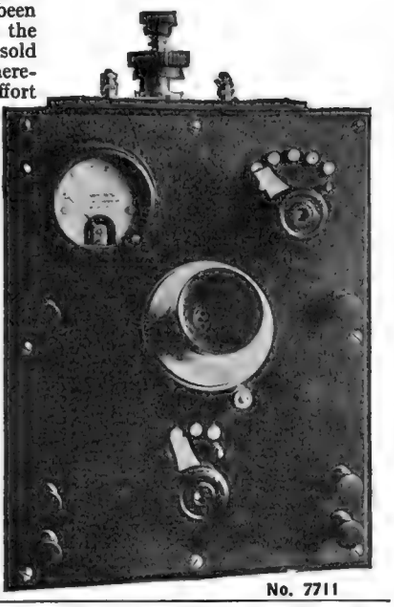
Arc for Generating Undamped Waves for Radio Telephonic & Telegraphic Transmission

These instruments are the acme of perfection in Radio Transmission. The latest and best developments in Radio during the *Great War* are embodied in this apparatus. Educational Institutions and Laboratories can now procure the most modern Radio equipment at a reasonable cost. The undamped *Wave Generator* illustrated is exceptionally well constructed of heavy aluminum. The Arc chamber is flanged in order to offer the greatest cooling surface. The Arc takes place across two solid special Tungsten electrodes which have been found particularly efficient for this work. The electrodes are fully adjustable, permitting very precise adjustment of the emitted oscillatory currents.

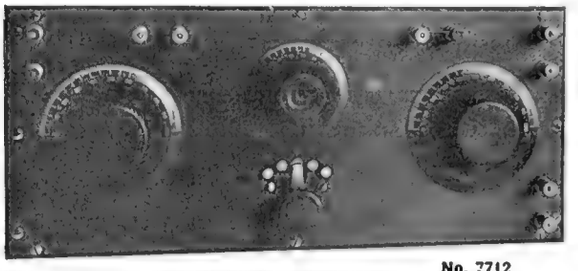
No. 7710—½ K.W. Sustained Wave Generator, as illustrated, operates on 110 V D.C. Size 6½ x 6½ x 8½. Shipping weight, 35 lbs.; price.....**$50.00**

This complete ***Radiophone Transmitter*** is unquestionably one of the finest pieces of Radio apparatus ever placed on the market. A Radiophone might have been sold heretofore; but it was felt that in justice to the purchaser, no instrument of this nature should be sold unless it were possible to obtain efficient results therefrom. This transmitter is the result of great effort expended in the design of a Radiophone set which should meet all requirements as to practicability and compactness combined with highest efficiency. It includes all apparatus necessary for transmission. The Arc is similar to the one illustrated elsewhere on this page.

No. 7711—Complete Sustained Wave Radiophone and Telegraph Transmitter, inclosed in a beautifully finished cabinet; size 14½ x 9 x 12½"; weight 50 pounds; as illustrated; price.....**$150.00**



No. 7711



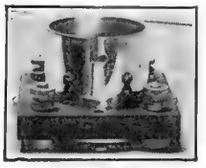
No. 7712

The Short Wave Regenerative receiving cabinet shown is built in accordance with the most modern methods of reception. In work with oscillating audions it is necessary that all losses be diminuated as it was found that tuning should preferably be done with inductance alone, without using variable condensers.

This Receiving set will be found fully up to the mark in comparison with the highest priced set on the market to-day, yet its cost is well within the reach of all.

No. 7712—Regenerative Receiving Cabinet set, as illustrated; size 16¾ x 7⅝ x 8"; weight 25 pounds; price.....**$50.00**

The Vacuum Tube Socket illustrated was designed to be used by those who are desirous of assembling their own vacuum controls and who need a good socket to hold the bulbs. It is well designed, durable and reasonably priced.



No. 7715

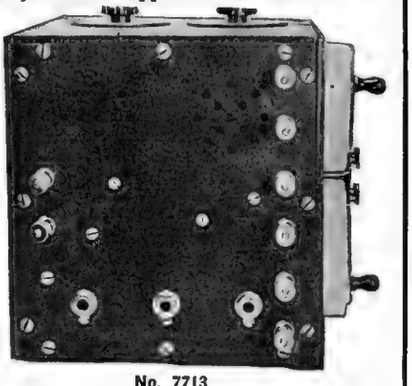
No. 7715—Vacuum Tube Socket; 2¼ x 2¼ x 1½"; weight 1 pound; price.....**$1.50**

This Tube socket is adaptable for both receiving and transmitting tubes.

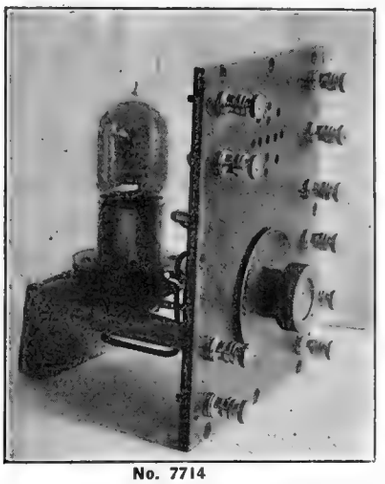
The Two Step Amplifier illustrated is undoubtedly one of the finest instruments offered to the experimenter. It is an example of unsurpassedly efficient apparatus combined with exceptional mechanical skill in its design and construction. Two Vacuum Tube sockets are mounted within the cabinet which also contains the two amplifying audio-frequency transformers which were especially designed for this instrument. It is of great consistance in amplifying live and radio telephone currents.

The telephones are plugged in any of three jacks mounted on the panel, permitting the use of either one or two steps of the amplifier or simply cutting the amplifier out entirely.

No. 7713—Two Step Amplifier, as illustrated; size 7⅝ x 7¼ x 8"; weight 7 pounds; price.....**$55.00**



No. 7713



No. 7714

The Vacuum Tube Control Cabinet is one of the essential instruments of the modern radio station. The Vacuum Tube holder, filament, rheostat, grid condenser and grid leak are mounted within the cabinet, the only part on the exterior being the rheostat control knob and dial. The construction throughout is on the same high level of excellence with the other instruments illustrated on this page.

No. 7714—Vacuum Tube Control Cabinet, as illustrated; size 6 x 7⅝ x 6¾; weight 5 pounds; price.....**$25.00**

P. S. No Tubes furnished by us with these instruments.

THE ELECTRO IMPORTING CO.

MANUFACTURERS

231 FULTON STREET N. Y

SEE OUR FULL PAGE "AD" ON PAGE 392

Telephone Solves "Lower Berth" Squabble.

(*Continued from page* 408)

The disadvantages of this system of distribution of cards are numerous, the greatest one being that while one agent may entirely fill his cards, another may not, and thus there will be vacancies in spite of a heavy demand at some other window. Added to this there is a good deal of time wasted while the ticket agent is trying to get in touch with some other agent who has a berth open, not to mention your good time and patience wasted while waiting for him to get the desired information.

But this new system which has been installed in the Grand Central Terminal obviates all this. All the time and energy that were formerly wasted are now saved by the creation of one central telephonic distributing system, which has been installed on the second floor of this railroad terminal and known as the *Pullman Distributing Office*. It is kept open all night long, and in it are maintained all the records and diagrams of every parlor and sleeping car operating out of the terminal.

Altogether this office takes care of the seventeen groups of ticket offices spread over New York City, Weehawken, and Yonkers.

This whole system was built especially to order for this railroad company, the idea being the outcome of a long and exhaustive study of the problem by Mr. Neil Mooney and Mr. Devlin, of New York City.

The equipment proper consists of a distributing board 18 feet long, 3½ feet wide and 2½ feet high. For its whole length this is surmounted by a rack containing pigeonholes which accommodate 190 sets of diagrams. This distributing board is built in three sections, with four operators to a section, each operator being assigned a certain set of trains. On the table in front of her is a set of signal lights, and she is equipt with head 'phones and a mouthpiece as shown in the illustration.

In all of the seventeen groups of ticket offices taken care of a duplicate set of buttons is given to each ticket agent. (See illustration.) He is also furnished with a key showing which operators are taking care of certain trains. By this method the agent in Yonkers or at any of the other stations presses a button, and instantly a light flashes before an operator in the distributing room, who answers "All right", —then the conversation runs like this:

TICKET SELLER:
"25.
"Chicago.
"Thursday, April 10th.
"Lower."
PULLMAN CLERK, at Distributing Board:
"All right."
TICKET SELLER:
"1776" (meaning railroad ticket number).
PULLMAN CLERK:
"Lower 12.
"Car 42.
"25.
"Chicago.
"Thursday, April 10th.
"1776."
TICKET SELLER (repeats):
"Lower 12.
"Car 42.
"25.
"Chicago.
"Thursday, April 10th.
"1776."

Translated into good English language this means that a lower berth is desired on train No. 25, the 20th Century Limited, on Thursday, April 10th, New York to Chicago. This formula reduces conversation to a minimum, and is very strictly adhered to. No girl is given "another chance".

At one side of the room are several desks which take care of nothing but telegraphic requests for reservations. Nearly a thousand requests per day are received, and it is easily seen that this forms no small part of the day's work.

Because of this concentration of distribution space may be sold until two minutes before the train leaves, when the diagrams are sent by special messenger from the distribution office to the conductor of the train.

There is one more feature that deserves mention, and that is the entire absence of all bells. All the signals and calls are made by different colored lights. The only time a bell rings is when one of the different circuits opens, or a fuse blows, in which case an expert electrician is immediately set on the job, and the trouble is fixed up very quickly.

Possibly a word as to the operators themselves would not be amiss. They are all well educated girls, some of them from college, a number of them having husbands in the American Expeditionary Force. The majority of them have been chief operators at some other exchange, and all of them have exceptional "speaking voices." The head of that department, Mr. Devlin, was very careful to make clear the difference between the "speaking" and the "talking" or "telephone" voice. A beginner there is paid $87.50 per month, and the more experienced operators get $125. In return the company demands a most rigid discipline while on duty, but at the same time everything is made as pleasant as possible for the girls. On the floor above is a big rest room fitted up with easy chairs and sofas, where the girls may go whenever they feel sick or faint.

Taken all together, the New York Central Railroad is doing its best to present to the long suffering public a good and efficient method of coping with the Pullman proposition, and they feel that their present method is nearly 100 per cent efficient.—*Photos courtesy New York Central Lines.*

Twin Cell Design of Dry Battery

(*Continued on page* 413)

each consisting of flat zinc strips 15/16 in. wide by 24 in. long, bent in the form of a letter "M." The maker points out that these zinc anodes present to the material contained in the cell a surface of around 90 sq. in., as against 42 sq. in. in a round design. It is therefore claimed that the density of current per square inch is greatly reduced with an increase of life of the cell that is of great practical importance.

The common positive electrode can be used with either negative electrode separately or together by joining the two negative electrodes by a connection. This is the way the battery is furnished. Either half of the battery will give 1½ volts, so that when only one-half the cell is used, the remaining half is kept fresh. The battery measures 1⅛ in. by 3 in. by 6 in., and weighs 2 lbs. 2 oz. The outside case is waterproof and non-conducting. On test it is claimed the battery has shown a voltage of 1.5 to 1.55 and on short circuit a current of 35 amperes.

Sent up by Italian scientists, a balloon carrying recording instruments reached an altitude of 23 miles and found the lowest temperature, 70 below zero, 12 miles from the earth's surface.

Become a Doctor of Chiropractic
Advanced Science of Spinal Adjustment

This is the day of drugless healing! In Chiropractic—treatment of disease by spinal adjustment—Science has made a forward step. Look at the newspapers and magazines—note the trend toward the principles of drugless healing, especially Chiropractic.

You can now become a Doctor of Chiropractic through home study during spare time! We teach you thoroughly either by mail or in class. You can know independence and position! Makes no difference where you live or what you do—you should be able to qualify for this great profession. Some of our graduates report that they

Earn $3,000 or More a Year

Dr. M. D. Moore, Ky., writes of having 17 patients in one day at $2 each. Dr. L. H. Roche, New Jersey, $5,550 a year. Dr. A. H. Morrow, of Illinois, reports earning $22 a day. We could name many other Chiropractors who are making good incomes. See the facts in our Free Book. It's only a question of preparation on your part, to enter a profession that is paying others $3,000 to $5,000 or more a year. Think what it would mean to you to earn such an income and to be your own boss with your own hours. Isn't this the kind of life you are desirous of leading? Well, it is now within your reach. Truly this is a chance for you!

22 CHARTS FREE

$15 Set of 8 Anatomical Charts and $16.50 Set of Nerve and Pain Area Charts

Yes, free to you without a cent, now or later. As an inducement to secure quick action, we will give absolutely free, our big, 72-page book; a $15 set of eight Anatomical Charts, beautifully lithographed in lifelike colors, and also a complete set of colored Nerve and Pain Area and Concussion Charts, regular value, $16.50.

Our Lessons Teach You How to Make Spinal Adjustments for the Speedy Relief of

Headache, Indigestion, Lumbago, Epilepsy, Pleurisy, Constipation, Rheumatism, Neuralgia, Neuritis, Catarrh, Fevers, Jaundice, Dyspepsia, Paralysis, Asthma, etc.

Learn At Home In Spare Time

We train you by mail. You can learn at home in your spare time. You receive the personal instruction of men who are prominent in this great profession. Give us a portion of your spare time, and we will quickly train you to become a Doctor of Chiropractic, ready to step out and take your position of prestige in the world.

Mail Coupon NOW! Why slave your life away in work that you don't like—work that doesn't fit with your ambition? Here's the chance you've been looking for—the opportunity your ambition has sought! Mail coupon today and see the success that may be yours as a Doctor of Chiropractic. Don't delay.

AMERICAN UNIVERSITY
Manierre Bldg. Dept. 550 Chicago, Ill.

Without cost or obligation, send me by mail, postpaid, your new illustrated 72-page book, and your Free Charts Offer.

Name .....

Street and No. .....

City ..... State .....

Turn A Valve and Cook

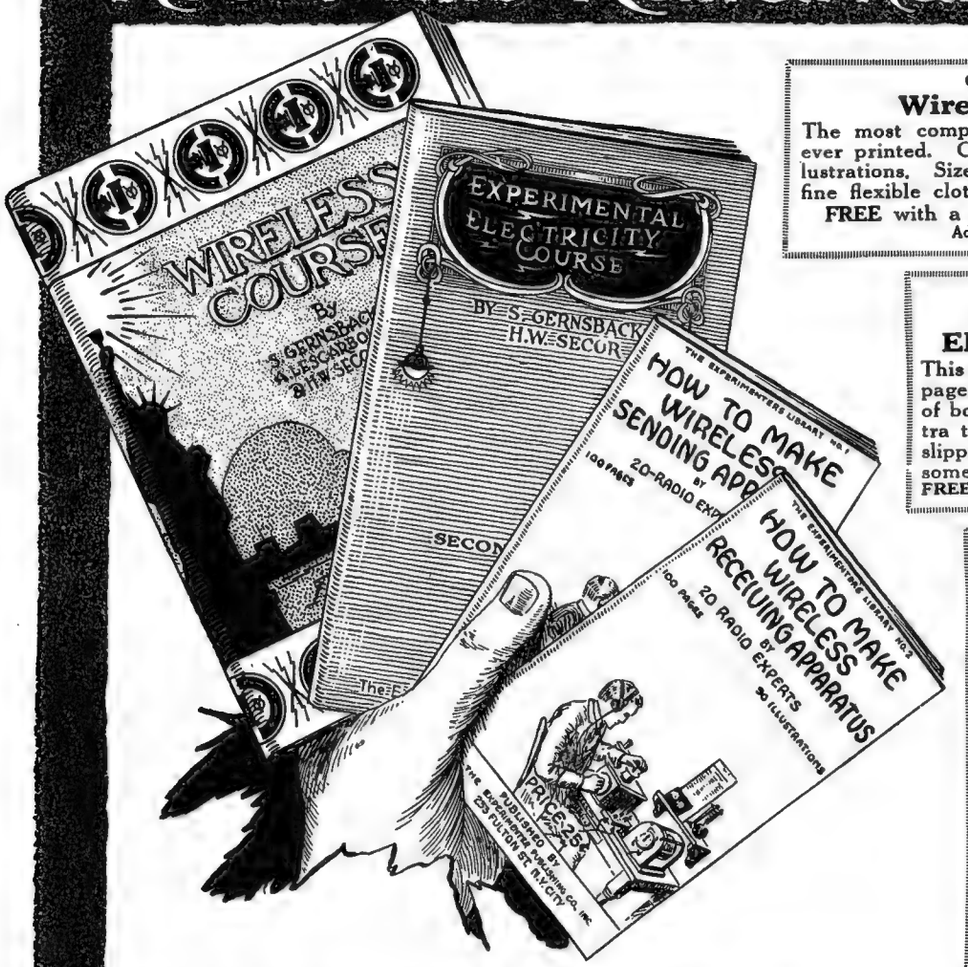
The OLIVER Oil-Gas Burner makes any stove or range a gas stove. No coal or wood. Cooks and bakes better. No fires to start. You regulate flame. Saves money, work, dirt. Burns coal-oil (kerosene). Simple, safe, easily put in or taken out. No damage to stove. Lasts a lifetime. Thousands of delighted users. In use seven years. Write us for FREE literature telling how 2 gals. kerosene equals 87 lbs. coal. *Agents Wanted.*
Oliver Oil-Gas Burner & Machine Co.
1345 N. 7th St., St. Louis, Mo.

Make Your Stove A Gas Stove

You can be quickly cured, if you
STAMMER
Send 10 cents coin or stamps for 70-page book on Stammering and Stuttering, "Its Cause and Cure." It tells how I cured myself after stammering for 20 years.
Benjamin N. Bogue, 758 Bogue Building, Indianapolis

FREE TO YOU!

Read this Remarkable Offer!



OFFER No. 1

Wireless Course

The most comprehensive Wireless Course ever printed. Contains 160 pages, 350 illustrations. Size of book 6¾"x10". Very fine flexible cloth cover.

FREE with a year's subscription.
Add 5c for postage

OFFER No. 2

Experimental Electricity Course

This masterpiece contains 160 pages, 400 illustrations. Size of book 5"x9". Printed on extra thin paper, so book can be slipped into pocket. Handsome flexible cloth cover.

FREE with a year's subscription. Add 5c postage

OFFER No. 3

How to Make Wireless Sending Apparatus
By 20 Radio Experts

How to Make Wireless Receiving Apparatus
By 20 Radio Constructors

These books are by far the most successful wireless books on the market. Size of each book 5"x7", well bound on good book paper. Covers in two colors. We really cannot praise these books too highly. Each book contains 100 pages and from 88 to 90 illustrations. **BOTH** books **FREE** with a year's subscription. Add 5c for postage

This is a very limited offer. It may be withdrawn at any time, due to the tremendous cost of paper, which IS JUST DOUBLE WHAT IT WAS ONE YEAR AGO. We have only a limited supply of these fine books on hand; after they are gone we cannot reprint the books until conditions become normal again. **Now is your chance.**

The publishers of this journal have earned an enviable reputation of giving more than 100 cents' worth for each dollar spent with them. Profit by this liberal opportunity NOW; it may never be made again.

HERE'S THE OFFER

Subscribe to the ELECTRICAL EXPERIMENTER for one year, at the **regular subscription price** of $2.00 per year (Canada, foreign and N. Y. C. $2.50) and we will send you either books shown in one of the above offers. If you subscribe for two years, two offers will be given, etc.

If you are a subscriber at present take advantage of this wonderful opportunity anyway. If you do, we will extend your present subscription.

This Offer Limited. ***Act Now.***

EXPERIMENTER PUB. CO.
233 FULTON STREET NEW YORK CITY

FILL IN — TEAR OUT — AND MAIL

9-19

Gentlemen:
Please enter my subscription to the ELECTRICAL EXPERIMENTER for the term of .... year..for which I enclose herewith $.....
You will also send me at once FREE your book..... as per offer No.....
.....
.....
Name.....
Address.....

A Tell-tale Submarine Net

(*Continued from page* 406)

holding the net sets in motion the signaling alarm devices provided by the inventor.

The anchoring devices at each end of the net each comprise a buoy in the form of a cylindrical body or tube containing an air chamber and ballast at the lower end. The lower end of the buoy is connected with a number of chains having weights or anchors at their lower extremities, and all of which may be adjusted and set to maintain the net or nets at the usual depths traveled by submarines. A series of nets can be arranged at various levels so as to form an effective barrier wherever required. The buoys remain in their original position, even if the net is detached by the submarine, and can be used for replacing another net.

Each buoy carries a float chamber having a dependent stem extending into a chamber at the upper end of the main buoy, and on this stem is placed a spool carrying a cable. When the net is pulled away from the anchoring devices, a set of catches disengage the spools so that the floats rise to the surface of the water and are carried along by the net. The float will thus serve to indicate that the net has been torn away from its anchorage by a submarine enmeshed therein, and moreover indicate the position of the sub-sea raider. At the same time a set of *marker floats* rise from the buoys to indicate their position.

In order to detect a submarine that has enmeshed with the net during the night, the float devices have suitable illuminating means which are easily set into operation by electric current. The float chamber contains a storage battery or other source of current connected in circuit with lamps adapted to be illuminated when the circuit is closed, by a special time-clock device connected with the release mechanism of the buoys. At the same time that the signal lamp circuit is closed in the floats, by means of the time-clock arrangement, an aërial bomb or rocket is projected into the air as shown in the accompanying illustration, this bomb being arranged in a barrel having at its lower end a charge of explosives, which is ignited by a spark plug connected up with an electric battery and spark coil circuit within the float. The bomb is fitted with a fuse, which will cause it to be exploded when it reaches a certain height. A red light or flare may be produced on the floats when the bomb is projected. For this purpose a charge of *red light* or other signal powder is arranged in a compartment within the float chamber.

ELECTRIC SHIP WELDING SUPERIOR.

The displacement of riveting by electric welding in ship construction is being considered in English insurance circles, with regard to possible reduction in rates. It is claimed that welded plates stand the impact test as well as riveted plates, but underwriters require further information on the question of the results of stranding and collision. The cost of electric welding is stated to be much below that of riveting, and if similar insurance rates may be secured will undoubtedly supplant riveting to a great extent.

A New Cam Regulator for Auto Dynamos

(*Continued from page* 415)

A number of voltage regulators have been developed, but of these only two—the bucking-winding system and the third-brush system—have been generally used. To these has been recently added a third, the Cam-Regulator System.

This system is very different from the usual systems both in principle and in operating characteristics. Some of the chief advantages claimed for it are as follows: The voltage is held more nearly constant than is the case with the other systems. Ideal battery-charging conditions are provided, since the amount of current delivered to the battery is large when the battery is discharged, and small when the battery is full. The battery is not necessary to the proper operation of regulator. Hence, in an emergency the generator can be operated with the battery disconnected, and in some cases the battery can be dispensed with altogether.

The generator for this system is of the simple *shuntfield* type, and voltage regulation is effected by *inserting resistance in the field circuit.* This principle is the same as that employed in ordinary power-generator service, but the method of application is quite different.

In power service the voltage of a generator is kept constant by increasing or decreasing the *amount* of resistance in series with the shunt field as the voltage tends to rise or fall. With the cam-regulator, however, a fixt amount of resistance is always used but the voltage is regulated by varying the *length of time* during which this resistance is in the field circuit. How this is accomplisht can be best understood by referring to the diagram of the cam-regulator.

This device consists of four main parts—a magnet coil and core, a set of contacts, a cam mounted on the generator shaft, and a resister. The resister is so connected that it is *short-circuited* when the contacts are *closed,* and *in series* with the shunt field of the generator when the contacts are *open.* The arm carrying the lower contact rests on the cam and is moved up and down with every revolution of the generator shaft. The upper contact is mounted on a pivoted arm, and when the generator is not in operation, it is prest against the lower contact by a spring finger.

With the engine running at low speed, as in starting, the contacts are together and the resistance short-circuited. When, however, an increase in the engine speed brings the voltage of the generator up to the operating point (7 volts), then the magnet comes into play.

The coil of this magnet is connected across the brushes of the generator, and when the voltage rises above 7 volts, it has sufficient strength to draw the upper contact away from the lower, thus inserting the resistance in series with the generator field. Immediately the voltage starts to fall, and the magnet drops the upper contact, closing the points and cutting out the resistance. This increases the voltage again, and the magnet picks up the contact, only to drop it immediately afterwards. Since the strength of the magnet's pull depends upon the voltage of the generator, the higher the voltage the longer the upper contact will be held, and the fewer will be the number of closings per minute. This is equivalent to an increase in the amount of resistance.

The operation of opening and closing the contacts takes place so rapidly that the eye can not follow it, nor can the variations in voltage be noted on a voltmeter. In practice the regulator is adjusted to hold the voltage at approximately 7 volts at all operating speeds and under normal loads.

—Photo courtesy Westinghouse Elec. & Mfg. Co.

DRAWING
Big Pay—Easy Pleasant Work

Draftsman earn $150.00 to $300.00 a month. The work is pleasant and the hours are short.
You can get this big pay too. All you need is the new 1919 edition of the Cyclopedia of Drawing and a little of your spare time. The cost is only 7 cents a day, and we give a year's consulting service free. See the FREE examination offer below.

Cyclopedia of DRAWING
4 big volumes each 5½x8¼ in., bound in genuine American Morocco and trimmed in gold 1578 pages and more than 1000 illustrations plates, diagrams and blue prints.

The only books that thoroughly cover Mechanical, Structural and Architectural Drafting in a non-technical way. You don't have to know anything about the subject to understand them. They begin at the beginning and tell you everything about Blue print Reading—Mechanical Drawing—Machine Design—Machine Drawing—Structural Drafting—Architectural Drawing and Lettering—Shades and Shadows—Perspective Drawing—Freehand Drawing—Pen and Ink Rendering—Typographical Drafting—Drawing Instruments and Their Uses and hundreds of other things connected with the work.

Use One WEEK FREE!
You can have these books for a whole week free without sending one cent. Just send the coupon below and all 4 volumes will come to you at once by express collect. Use them as if they were your own—go through them thoroughly and send them back at our expense if you don't want to keep them. If you do keep the books send us only $2.00. You can send the balance of our special introductory price—only $13.80 the same way—$2.00 each month.
Remember you don't take any chances. The risk is all ours and the benefits will all be yours—Send the coupon today

American Technical Society
Dept. D 256 CHICAGO, U. S. A.

American Technical Society
Dept. D 256
CHICAGO, U. S. A.
Please send me the 4-volume Cyclopedia of Drawing for 7 days' Free Examination, shipping charges collect. I will send you $2.00 in 7 days and $2.00 each month until the special price of 13.80 is paid, and you will send me a receipt showing the books are mine. If I decide not to buy I will return the books in 7 days
Name.....
Address.....
References.....

WANTED
RAILWAY MAIL CLERKS
$1100 first year
Examinations everywhere
Common education sufficient
Life Job.
Franklin Institute, Dept. J-101 Rochester, N. Y.
COUPON
Sirs:—Send me at once, free of charge, sample Railway Mail Examination questions, list of other U. S. Government positions now open and free book describing them.
Name.....
Address.....

FREE $20
Violin, Hawaiian Guitar
Ukulele, Guitar, Mandolin, Cornet or Banjo
Wonderful new system of teaching note music by mail. To first pupils in each locality, we'll give a $20 superb Violin, Mandolin, Ukulele, Guitar, Hawaiian Guitar, Cornet or Banjo absolutely free. Very small charge for lessons only expense. We guarantee success or no charge. Complete outfit free. Write at once—no obligation.
SLINGERLAND SCHOOL OF MUSIC, Dept. 422, CHICAGO, ILL.

Opportunity Ad-lets

YOU will find many remarkable opportunities and real bargains in these columns. It will pay you to read and investigate the offerings made every month by reliable firms, dealers and amateurs from all over the country. No matter what you may be seeking, whether supplies, automobile accessories, the opportunity to make money, or anything else, you will find listed here the best and most attractive specials of the month.

Advertisements in this section seven cents a word for each insertion. No advertisement for less than 50c accepted. Name and address must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency.

Ten per cent discount for 6 issues, 20 per cent discount for 12 issues. Objectionable or misleading advertisements not accepted. Advertisements for the October issue must reach us not later than August 22.

The Circulation of the Experimenter is over 115,000 and climbing every month

EXPERIMENTER PUBLISHING CO., INC., 233 Fulton Street, New York, N. Y.

Automobile Accessories.

Battery Charging Pays Big Profits. City current or gas engine operates. Easy terms. Hobart Brothers, Troy, Ohio.

Fords run 34 miles per gallon with our 1919 carburetors. Use cheapest gasoline or half kerosene. Start easy any weather. Increased power. Styles for all motors. Runs slow high gear. Attach yourself. Big profits for agents. Money back guarantee, 30 days' trial. Air-Friction Carburetor Co., 270 Madison St., Dayton, O.

Auto Motors and Supplies. Buick, Hupp, Franklin, Michigan, Everett, Hudson, Chalmers. Both water and air cooled motors, $40 each and up. Bosch Magnetos, $15 each and up. Presto Tanks, $5. Coils, Carburetors, Head Lamps, Horns, Air Compressors, Generators, Starters. Write for bargain bulletin second-hand auto accessories. Johnston, West End, Pittsburgh, Pa.

Attention! Device for carrying curtains in top of auto; complete directions; easily attached. Send $.35. No stamps. Johnston, 9 Rutherford, Binghamton, N. Y.

Agents Wanted.

Beginners. Complete "Mail Order System." C, Box 1005, Atlantic City.

10 to $25 a day profit. Biggest summer seller. Concentrated fruit drinks. Just add water. Delicious drink in a jiffy. Six popular flavors. Bestever Products Co., 2426-SE-9, Polk St., Chicago.

Insyde Tyres, inner armor for automobile tires, double mileage and prevent punctures and blow-out. Quickly applied. Costs little. Demand tremendous. Profits unlimited. Details free. American Automobile Accessories Co., Dept. 54, Cincinnati, O.

Agents. Big returns, fast office sellers; particulars and samples free. One Dip Pen Co., 12 Daily Record Bldg., Baltimore, Md.

Signs for store and office windows. $50 a week easily made. Chicago Sign System, G 326 River St., Chicago.

$10 Daily refinishing chandeliers, brass beds, automobiles by new method, without capital or experience. Free particulars and proofs. Write today. Gunmetal Co., Ave. D, Decatur, Ill.

Wonderful Chance—Men's shirts and furnishings at wholesale rates, or make $10 daily starting real business. Goodell Co., Duratex Bldg., New York.

We may have it. Money getter. Sample 25 cents. Box 802, Baltimore, Md.

Patents for Sale.

Wireless apparatus patent for sale. High merit. Information, pictures, address Mr. Teele, 139 Genessee St., Buffalo, N. Y.

Scenery for Hire.

Collapsible Scenery for all plays. Decorations. Amelia Grain, Philadelphia.

Old Money Wanted.

We Buy and Sell Old Coins. $2 to $500 each paid. Keep All Old Money; you may have valuable coins. Send 10c. for New Illustrated Coin Value Book, 4 x 6. Guaranteed prices. Get posted. Clarke Coin Co., Box 110, Le Roy, N. Y.

Salesmen Wanted.

Salesmen—Commercial Travelers and City Salesmen, no previous experience necessary; trained men earn from $200 to $1000 monthly; prepare now by mail for the "big paying jobs." Write for free book and special offer today. Interstate Commercial Institute, 1133 Broadway, New York.

Postcards.

Five Prettiest Women Cards, hand colored, 25c. Chas. Durso, Dept. 41, 25 Mulberry St., New York City.

Rare Real Photos: Bathing beauties, models, the kind you want. Sample, dime. Write. Artiste, Auburn, Ind.

News Correspondents.

Earn $25 Weekly, spare time, writing for newspapers, magazines. Experience unnecessary; details free. Press Syndicate, 566 St. Louis, Mo.

Jacobus Advertising Service

SALES COMPELLING LITERATURE

1073 Sanford Ave. Irvington, N. J.

July 17, 1919

ELECTRICAL EXPERIMENTER,
N. Y. City.

Attention, Mr. DeMott.

Gentlemen:—Herewith two small ads. for next issue of your two magazines. We also expect one along in a day or so from a Cartoon School out in Pennsylvania, but he is making a drawing for same and no doubt this is what is delaying it. As soon as we receive it we will rush it right over to you.

Your magazines are pulling good for us and it all seems to be a good class of trade, which indicates your readers are wide awake and answer ads.

Very truly yours,

H. JACOBUS.

Cameras, Supplies—Photo Developing.

Clean, Neat, Perfect Kodak Finishing at the lowest prices. Work returned the same day received. Send film for sample print and copy of catalogue on developing, printing, enlarging and hand coloring, also copy of Photo Craft Magazine, which will help you make better pictures. Photo Craft Co., Box 69, Ann Arbor, Mich.

For 15c we will develop and furnish prints from one, six or eight exposure film or enlargement 8x10, your favorite negative, 20c to show quality and service. Associated Photo Company, Sta. A 12, Cincinnati, Ohio.

Roll Film Developed, 6c. Prints, 2c up. Send for price list. The Blad Photo System, Wareham, Mass.

Mail us 15c with any size film for development and six velvet prints. Or send six negatives any size and 15c for six prints. Or send 35c for one 8 x 10 mounted enlargement. Prompt, perfect service. Roanoke Photo Finishing Co., 255 Bell Ave., Roanoke, Va.

Exchange Ads.

Exchange, Buy, Sell. Wireless, electrical goods, etc. Large list 6c. State what you have and want. Zehrbach, Box 250, Hiram, O.

Wanted Tribune light car or parts. State lowest cash price and full particulars. Van Deurs, 325 Beta Place, Glendale, L. I.

Photographs wanted of Autolite and Hoyt (Gray-Davis) automobile Ammeters. Also speedometers. Will pay $1.00 each. Write Victor Todd, Rainbow Lake, New York.

Amateurs! Complete Audiotron regenerative cabinet, $18.50. Write for photo and particulars. H. Springfels, 70 E. Utica St., Buffalo, N. Y.

Let's swap! What'ye got? What d'ye want? Free Advertising. Three months, dime. Swap Bulletin, Wayne Congress, Detroit.

Sell—Gilbert's $10 Electrical Set. Tank developing outfit. Fine condition. Write. James Raiford, Route 1, Bessemer, Alabama.

2-$4.00 3-slide tuning Coils, sell for $2.50 each. 1-Murdock Loose Coupler, cost $8.00, sell for $5.00. Instruments used only 2 months. Prepaid. Sidney Kronengold, 5508—5th Ave., Brooklyn, N. Y.

For Sale—DeForest audion on panel, Oscillation Transformer and sending, receiving switch, $8. Also I.C.S. Electric Lighting Course, $20. Stamp for particulars. Eldred Hall, Solvay, N. Y.

Sell; Curtiss 3-ft. Biplane, $8.50. Guaranteed to fly. Complete arc light, $8.00. Send for photos. Merlin F. Harrod, New London, O

5000 Meter Coupler and other instruments for sale. Write quick. Ritchey Hume, University, Mississippi.

For Sale—Transmitting set, including 2" coil, helix, condenser key and gap, $15.00. Also Knapp dynamo-motor, $4.00. H. Hilton, 20 Jewett St., Amsterdam, N. Y.

Amateurs. Write me for list of Radio Apparatus for sale at big bargains. All in good order; closing my station. Wendell Holst, 3619 N. St. Louis Ave., Chicago.

65 Chemical Set, $5.00. Bricktor, $4.00. Lionel Gates, Coalport, Pa.

Sell 1/20 H.P., 110 volt, 60 cycle continuous duty induction motor, $7; 40 watt dynamo, $4.50; 20 watt dynamo, $2.25; volt and ammeter, $1.25. Adolph Gedeon, 3296 W. 50th St., Cleveland, Ohio.

For Sale or Exchange—$40 Hawaiian Guitar outfit, $25. Write. Arthur Ellwein, Wrightsville, Pa.

Chemical Laboratory for Sale. 100 Chemicals—50 pieces of apparatus, cheap. Louis Dotte, 205 West St., West Hoboken, N. J.

Must Sell. Send stamp for list of electrical goods. Earl Cook, Benardston, Mass.

Bargain. 1 K.W. Thordarson transformer, brand new, $21.00. Crawford, 13 Ten Broeck St., Albany, N. Y.

For Sale. Blue prints for connecting A.C. motors. See ad under "Blueprints." Charles Chittenden.

Sell—Valuable electrical Stereopticon. First money order gets it. Thompson, 36 John St., Worcester, Mass.

Exchange! Over 100 "American Boys," also other Magazines for something electrical, letters answered. W. Leslie, Oak Hill, Ohio.

Trade—Moving Picture Camera, 150 ft. capacity; for small lathe. Ora Coppock, Tipton, Ind.

For Sale—Nickel plated; short model Valve Trombone. Ralph D. Kors, Humboldt, Neb.

For Sale—Audion, complete, except bulb, $6.50; Walnut case, no bulb or battery, $3.50; Blitzen, ¼ K. W. transformer, mounted, $10.00; Audion coil, $1; 55 galvanized pole steps, $1.00; Double variometer, $2.50; Telegraph outfit, $1.00; 30 Algier stories, $2.50. Rule D. Egbert, Tiffin, Ohio.

Will Exchange 5 H.P. gasoline engine for shot gun. Schmelzers, 90 St. Marks Place, New York.

Sell—Electrical apparatus. Thompson, 36 John St., Worcester, Mass.

Sale—22 Remington Rifle $5.00. Two telegraph sets $4.00. No. 6 Erector $5.00. Electric Miroscope $4.00. W. Grus, 505 Clinton Ave., Oak Park, Ill.

Electrical Supplies & Appliances.

Battery Charging pays big profits with HB Equipment. Electric Light Generators and Motors can also be furnished on easy payments. Full information free. Hobart Brothers, Troy, Ohio.

Storage Batteries. Make the plates yourself, we will tell you how. Sample plate 40c. Windsor Specialty Co. (not incorporated), 5419 Windsor Ave., Chicago, Ill.

Castings, Blueprints, Engines—Gas and Steam, ⅛ H.P. up. Gears, Pulleys, Pumps, Fittings, Small Boilers. Complete circulars for stamp. Latest models. Universal Gas Motor Co., 364 Monadnock Block, Chicago.

Storage Batteries charged by alternating current. Inexpensive, Simple and Efficient; Instructions and Print $1. K. & S. Engineering, Box 124, Sewickley, Pa.

Magnets: Large Horseshoe Magnets. Will lift 12 lbs. Mail $1, stamps or Money Order. Parcel Post Prepaid to all parts of U. S. or Canada. West Side Novelty Co., Drawer No. 8 Wabash P. O., Pittsburgh, Pa.

Motor Winders. See ad under "Blueprints." Charles Chittenden.

100 induction motor winding diagrams, 1, 2, 3 phase, star delta. 2 to 12 poles inclusive. Postpaid, $5.00. W. Glass, 2108 South Broad St., Philadelphia, Pa.

Electrical Workers and all others who are interested in Electrical Work in the Reconstruction that is taking place. To send us their name and receive descriptive literature of our Modern Blue Print Chart Method of Electrical Wiring. Souvenir information card included. Electrical Wiring Diagram Co., Box C. 173, Altoona, Pa.

Lava Insulation is not molded but individually sawn, lathe turned, milled, drilled, threaded. No limitation on form, only on size. Kilned at two thousand degrees. Hard, strong, accurate, fire, acid proof. Ask for book. American Lava Insulator Company, Chattanooga, Tenn.

Chemicals.

Radioactive and Rare Metal Salts. An opportunity for experimenters to become acquainted with radioactivity and rare metals. Ten salts in neat tubes—Thorium, beryllium, unranium, cerium, and others. Price only $1.75. Radio Chemical Supply Co., 915 Westcott St., Syracuse, N. Y.

Chemicals—We have the best chemicals at the lowest prices. Write for circular. Jos. Simpson, 3880 Windsor Place, St. Louis, Mo.

Experimenters—August list and 10 formulae—5c. Chemicals and laboratory apparatus for analytical and experimental work. Do your reactions ever go wrong? Our chemicals for analytical work are guaranteed c.p. C. C. Frane, Eureka, Ill.

For Advertisers.

Jacobus Ads. Are Business Builders. Booklet Free. Jacobus Advertising Service, 1073 Sanford Ave., Irvington, N. J.

"Quick-Action Advertising—How it is Building Business for the Progressive Advertisers of America"; A little story of results told by the advertisers themselves—not the publisher. You will be interested in reading this little booklet which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield Coutlee, 225 West 39th St., New York.

Advertise—24 words in 100 magazines, $1 lists Free. Stanford Co., 308 Hostetter Bldg., Pittsburgh, Pa.

Personal.

Are You Self-Conscious, embarrassed in company, lacking in self-control? These troubles overcome. C. E. Veritas, 1400 Broadway, New York City, N. Y.

Get Vital Strength. Retain youthful vigor. Wonderful results. Intensely interesting booklet free. Winslow H. Chase, Washington, D. C.

The Salesman Wins. Thousands of positions open. We teach traveling salesmanship by mail and guarantee offer of position or refund tuition. For interesting particulars, address Kansas Vocational Bureau, Miltonvale, Kansas.

Novelties

Here Boys! Make a Toy Aeroplane. See our Nifty ad., page 454.

Wanted to Buy

Cash for Old False Teeth. We pay up to $35.00 per set (broken or not). Also buy discarded gold jewelry, gold crowns, bridges, platinum, diamonds, watches and silver. Send now. Cash by return mail. Package held 5 to 10 days for sender's approval of our offer. U. S. Smelting Works, Dept. 73. Chicago, Ill.

Formulas.

Whiskey. I will not sell a million formulas for $1.00. My little book of selected formulas will put you wise. Every formula has been carefully selected and plainly printed. Tells you how to make excellent whiskey or Beer with a good Kick at small cost. A few good formulas are worth a million bad ones. Complete book and formulas $1.00 bill. I'm prompt too. Frank Ward, Box 503, Baltimore, Md. Dept. D.

500 Successful money-making formulas and trade secrets. Postpaid 25c. Charles Dynes, Winchester, Ind.

Motors, Engines & Dynamos.

Small Motors and Generators from bankruptcy and receivers' sales. Motors for all phases of current. Immediate delivery. Less than one-half regular prices. See display ad on page 459. Johnston, West End, Pittsburgh, Pa.

For Men.

Send us your dull razor blades. We re-edge them Good as New, any kind, 2½c each. Prompt service and satisfaction guaranteed. Dealers wanted. Keenedge Company, Inc., 184 Washington St., Chicago, Ill.

Detectives Earn Big Money. Travel. Great demand. Experience unnecessary. We train you. Write for free particulars. American Detective System, 1968 Broadway, N. Y.

Dredge's Necktie Valet removes wrinkles (without ironing) from neckties. Sample 25c. Dept. E, 190 Pilgrim, Highland Park, Mich.

Wireless.

Radio Apparatus of Quality. Manufactured to your own specifications. Radio Engineering Company, Baltimore, Md.

Switch Points. Binding posts, switch levers, and small parts, send 2c. for catalogue describing these and other goods. A. W. Bowman & Co., 23 Church St. (Harvard Square), Cambridge, Mass.

Wireless, improved switch-knob lever, complete, 25c; brass switch points with screws, 25c dozen; Magnet wire, 22-24, 50c, 26-28, 60c half pound, postpaid prices. Amateur parts our specialty. Electro-Novotoy Shop, 2100 Fifth, Charlotte, N. C.

Panel Wireless Sets and Parts. Heavy rubber Knobs. $1.10, post extra. Klaus, Eureka, Ill.

"Bargains"—6000 ¼" Spark coils without vibrators must be sold at once. Send 40c and 12c postage. Also ¼" Spark coils with vibrators, at 85c and postage. A. Dubs, 1534 Pitkin Ave., Brooklyn, N. Y.

10,000 feet stranded aerial cable, seven strands number 22 pure copper. The need of the hour. 1 cent per foot, $9.00 per thousand. L. A. Bates, 8 Moen St., Worcester, Mass.

For Inventors.

Inventors join National Institute of Inventors, 118 Fulton St., New York City; membership society 1,900 strong; will help protect, develop, finance and market your invention. Absolutely no charge. Write for booklet.

"Sell or Finance Inventions." Read Money Talks Magazine. Send for free sample copy. 70-B Park Place, Newark, New Jersey.

Inventors. Protect yourselves. Record your idea before exposing it to anyone, even to me. Paul E. Klein, M.E., Consulting Engineer, Registered Patent Attorney, 21 Park Row, New York.

600 Mechanical Movements, also illustrations and explanations of 50 perpetual motions. My book, Inventors' Universal Educator, 4th edition, tells how to procure and sell a patent for your new invention. Government and other costs. Covers the matter from A to Z. 140 pages elegantly bound. Contains noted Court decisions on Patent cases. Mechanical Movements greatly assist inventors—suggest new ideas that might prove of great aid in perfecting inventions. Tells how to select an attorney. Has valuable information regarding Patent Sharks, Selling Agents and Brokers. Price $1. Postage free. Fred G. Dieterich, 603 Ouray Bldg., Washington, D. C.

Inventions Wanted. Cash or royalty for ideas. Adam Fisher Mfg. Co., 205 St. Louis, Mo.

Inventors write me about patents. My fees payable monthly. Booklet free. Frank Fuller, Washington, D. C.

Business Opportunities.

Enter a New Business. Earn $3,000 to $6,000 yearly in professional fees making and fitting a foot specialty, openings everywhere with all the trade you can attend to; easily learned by anyone at home in a few weeks at small expense; no further capital required; no goods to buy; job hunting, soliciting or agency. Address Stephenson Laboratory, 18 Back Bay, Boston, Mass.

500% Profit Monograming Autos. "Perfect" transfers. Irvin J. Wolf, Sta. E, Philadelphia.

$30 a Week. Evenings I made it with a small Mail Order Business; continued my regular job daytime. Free Booklet Tells How, 2c postage. Albert W. Scott, Cohoes, N. Y.

Make $4.00 a Day Silvering Mirrors. Complete instructions, 10c (coin). Lloyd Stultz, Middletown, Maryland.

Build Up an Income in Oil. Others are doing it—Why not you? Today is the opportunity. Join our easy monthly payment plan now—it may mean hundreds in profits. Write for information. National Oil Drilling Co., Dept. K, Houston, Texas.

Dollars Yearly in Your Back Yard. No ginseng, mushroom dope. New ideas. Investigate. Particulars free. Metz, 313 East 89, New York.

Money-Making Farms. 19 States. $10 to $100 acre. Stock, tools, crops, often included to settle quickly. Write for big illustrated catalog. E. A. Strout Farm Agency, 150 E C Nassau St., New York.

Breed Canaries—Profitable pastime—Particulars free—Bird Farm, Lynnhaven, Virginia.

Victory. Mechanical Toy Soldier window attraction. 30 inches high. Salutes, turns head, points with finger, etc., as set. Well made, nicely dressed officers, privates, Uncle Sam, etc. Electrically operated. Does some stunt every half minute or oftener as set and will salute soldier and pay no attention to other if desired. Representative wanted in each city and town. Write for prices. The John M. Biggs Co., Box 324, Chattanooga, Tenn.

Radio Amateurs; Here is an opportunity for you to secure a very efficient amateur radio set complete. Photos and description furnished on receipt of postage. Address Clarence Bornofska, 1322 Lincoln St., Racine, Wis.

Complete Course on compiling and selling names by mail to advertisers. Description free. Globe Publishing Co., 120 Syracuse, N. Y.

"Let's get started once more, fifty complete, guaranteed radio receiving sets, $1.65 each." Eureka Manufacturing Company, Independence, Iowa.

"Quick-Action Advertising—How It Is Building Business for the Progressive Advertisers of America"; A little story of results told by the advertisers themselves—not the publishers. You will be interested in reading this little booklet which we have prepared for prospective advertisers, a copy of which will be gladly mailed to you upon request. It tells you how to talk business with 1,000,000 intelligent, interested and responsive Americans every month—men who know what they want and who have the money to buy it. Write for particulars and rates today. Douglas Wakefield Coutlee, 225 W. 39th St., New York.

Start a Profitable Business manufacturing "Puffed Crisp." Delicious confection. Whirlwind money-maker. Machine, Instructions complete $6.50. Samples 10c. Bestever Products Co., 2426-PE-9, Polk St., Chicago.

Blue Prints, 236 A.C. diagrams, contains 54 single phase, 42 two phase, 50 three phase Star, 40 Delta, 12 Star-Delta. Appendix 68 changes of voltage, phases, speed, cycles, etc. 10 samples 25c. Particulars free. Charles L. Chittenden, 811 West 18th Street, Kansas City, Missouri.

Salesmen—New proposition that nets $100 to $200 weekly. Give moving picture shows at schools, colleges, universities, chuches, Y. M. C. A's, clubs, lodges, societies and homes. We furnish complete outfit. Write for particulars. W. H. Wade, Dept. 5, 14 N. Michigan Ave., Chicago.

Make Big Money opening safes and setting combinations. Wayne Strong, P. O. Box 1430, Los Angeles, Cal.

Motion Pictures.

Electric Arc Generator halves expense. Your engine operates. Easy terms. Hobart Brothers, Troy, Ohio.

Earn $1200 A Year in Spare Time writing photoplays. Experience unnecessary. Send for free book, valuable information, special prize offer. Photo Playwright College, Box 278 E-5, Chicago.

Photoplays Wanted. Big prices paid. You can write them. We show you how. Free particulars. Rex Publishers, Box 175, E5, Chicago.

Continued on Page 486

Books.

Dear Reader. If Occult, New-Thought and Scientific books appeal to you, send for my catalog, it's free. I have books on Personal Magnetism, Concentration, Spiritualism, Clairvoyance, Seership, Will, Mind, Hypnotism, Messmerism, Character Reading, Healing, Mysticism Success, Salesmanship, Mechanics, Entertainment, etc. A. W. Martens, J-49, Burlington, Iowa.

World-Romic System. Masterkey to all languages. Six textbooks, $1.44; French chart, 37c.; Spanish, 37c.; aviation dictionary, $1.50; French-English aviation dictionary, 61c. Languages, 143 W. 47th St., New York.

A Magazine Published for Boys by boys. Year, 25c. Single copies 5c. Hoosier Boy, Brazil, Indiana.

"Chicago Mysteries" Illustrated Book, 25c. Catalogue, 2c. Paul Duff, 2713 Mozart, Chicago, Ill.

Nature Laws every married and engaged person should know, 45c (no stamps). Central Company, 599 Ninth Ave., New York.

To Get Better Pictures. Read the amateur photographers' weekly; illustrated; weekly prize competitions; print criticisms; many unique features; $1.50 per year; three months' trial subscription 25c. Abel Publishing Company, 401 Caxton Bldg., Cleveland, O.

Old E. E. Back Numbers. We have some valuable old E. E. back numbers on hand as follows: 1915—Jan., Feb., March, April, May, June, July, Aug., Sept., Oct., Nov., Dec., price each 35c. 1916—Jan., Feb., March, May, June, Nov., Dec., price each 35c. 1917—Jan., April, May, June, Aug., Nov., Dec., each 35c. 1918—March, May, June, July, Aug., Sept., 35c; Oct., Dec., each 20c. 1919—Jan., Feb., Mar., Apr., May, June, July, Aug., 20c. We can fill orders at once upon receipt of your remittance and if you have not these numbers already, now is your chance to get them, as they probably will be snapped up very quickly. Experimenter Publishing Co., 233 Fulton St., New York City.

Tricks, Puzzles and Games.

Tricks, Puzzles, Jokes, toys, games, novelties, doll and cane racks, plays, wigs, stage supplies, escapes and illusions. Large 1917 catalogue free. Oakes Magical Co. Dept. 549, Oshkosh, Wis.

Magic. Entertain at home. Tricks, puzzles, novelties. Big Catalogue A, 25c. Martinka & Co., Inc., Harry Houdini, President, 493 Sixth Avenue, New York City.

Black Art Hindoo experiments. 1919 edition, 25c. Invisible ink. Free trick. Catalogue each order. Lindhorst Magic X Shop, St. Louis.

Magic—Card Tricks. Sensational escapes, jokes, novelties. Everything in the amusement line. Large illustrated catalogue of a thousand tricks free. Write today. Largest amusement goods manufacturers in the world. Heaney Magic Co., Desk 205, Berlin, Wis.

Illusions—Stage Tricks with 500 Illustrations. Catalog 15c. Small catalog free. Hornmann Magic Company, 304 West 34th St., New York.

Ventriloquism taught almost anyone at home. Small cost. Send today 3c stamp for particulars and proof. O. A. Smith, Room R629, 801 Bigelow Street, Peoria, Ill.

Ten Magic Numbers, Hallowe'en Fun, $1.00. Belle Mason, Binghamton, N. Y.

Health.

Cigarette, pipe or chewing habit conquered. Nature's method. Guaranteed. Write for free brochure. Edw. J. Woods, TA-300, Station F, New York.

Tobacco or Snuff Habit Cured or no pay; $1 if cured. Remedy sent on trial. Superba Co., SA, Baltimore, Md.

Tobacco Habit Cured—$1 prepaid. Harrison, 105 Walker, Evansville, Ind.

Instruction

Questions answered. All subjects. Details free. Answerall Information Bureau, 51 Cliff St., N. Y.

Free Advice? No! Our advice is the best. We advise on any subject, no matter how complicated; we have the best experts. We also make translations from any language. Tell us about your problems. Any one can understand us. Our charges are nominal. We invite your correspondence. Phone, Forsyth 1690, if you wish. A trial will convince you. Remember, poor advice is dear at any price. Paragon Technical Bureau, 329 East Fifth St., New York City.

Telegraphy.

Telegraphy (both Morse and wireless) and Railway Accounting taught thoroughly and quickly. Big salaries now paid. Great opportunities. Oldest and Largest School—est. 45 years. Catalog free. Dodges Institute, 7th St., Valparaiso, Ind.

Help Wanted.

American Made Toys Wanted. An opportunity for homeworkers on small scale and manufacturers on large scale. Unlimited quantities needed of Toy Soldiers. Army, Navy, Marines, Cannons, Machine Guns, Warships and other Toys and Novelties. Greatest chance for industrious people for independent business. Enormous demand and future in American Made Toys, all over United States, Canada, Mexico and South America with over 50,000 10 cents stores and toy dealers. This new American industry stands out conspicuously. Factories are established, people trained, machineries made. Christmas Sets needed in millions this year. The great hit for 1919 without any competition. We are buyers of these goods all year, paying fixed prices. Attractive prices offered for painted goods. Experience or tools unnecessary. Hundred and more made complete per hour. Casting-form outfits from $3.00 up. If you mean business, send for booklet and information free. Toy Soldier Manufacturing Co., 32 Union Square, New York.

Wanted, Men. Become Auto Experts. $35 Week, Earn while learning. Franklin Institute, Dept. J. 806, Rochester, N. Y.

Men wanted for Detective Work. Write J. Ganor, Former U. S. Government Detective, Danville, Ill.

Secret Service Operatives and Detectives are in demand. Earn Big money. Travel everywhere. Fascinating work. Learn this profession by home study. Particulars free. American School of Criminology, Dept. E., Detroit, Mich.

U. S. Government Wants Clerks. Men—women 18 or over. $1,000-$1,600 year. Permanent clerical positions. List positions free. Write immediately. Franklin Institute, Dept. J. 26, Rochester, N. Y.

Stamps & Coins.

California Gold. Quarter size, 27c.; Half dollar size, 53c.; dollar size, $1.10; large cent, 1820, and catalogue, 10c. Norman Shultz, Kings City, Mo.

Stamps—61 All Different Free. Postage, 3c. Mention paper. Quaker Stamp Co., Toledo, O.

1,000 U. S. and Foreign Stamps, including Mexican Villa Dollar, 25c. C. W. Parker, 77 Kensington Heights, Meriden, Conn.

100 Different Stamps 12c.; 200, 27c. Michaels, 5600 Prairie, Chicago.

Best One Cent Approvals in America. F. P. Hand, 1117 So. 60th St., Philadelphia, Pa.

100 Different Stamps, 10c. 100 U. S., 25c. Buckey, 412 Bowen, Dayton, Ohio.

Stammering.

St-Stu-t-t-tering and Stammering cured at home. Instructive booklet free. Walter McDonnell, 105 Potomac Bank Bldg., Washington, D. C.

For the Hair.

Don't Use Soap. Shampoos containing Soap or Alkalies injure the Hair. "Tricon" Herb Shampoo made from Mexican Amole, and other Roots and Barks contain neither. Cleanses the Scalp, removes Dandruff, stimulates Growth, restores Softness and Gloss. 10 cents postpaid. Agents Wanted. W. L. McDaniel, Box 916, El Paso, Texas.

Do You Want Hair? You can have it by using The Ekdee Hair Cerate. 95% of baldness curable. Thin hair made thick. (Not a dye.) One month's trial sent postpaid for $2.10. The Ekdee Company, 800 Union Ave., North Portland, Oregon.

I Was Bald. Obtained hair growth by an Indian's ointment containing genuine bear oil and rare plant juices. Many others have good hair-growing results. Will send box, postpaid, with recipe, 10c. John Hart Brittain, 150 E. 32nd St., BA-300, New York.

Song Poems Wanted.

Write the Words for a Song. We revise poems, write music and guarantee to secure publication. Submit poems on any subject. Broadway Studios, 197C Fitzgerald Bldg., New York.

Write the Words for a Song. We write music and guarantee publisher's acceptance. Submit poems on war, love or any subject. Chester Music Co., 920 So. Michigan Ave., Room 265, Chicago, Ill.

Only Poems having commercial possibilities accepted. I revise poems, compose, arrange, edit and autograph music for Chicago's best music firms. Irving Ginrich, 646 Belden Ave., Chicago.

Printing.

500, 3 x 6, 2 Color Circulars, neatly printed and sent prepaid for only $1.00. Robinson's Print Shop, Portland, Conn.

500 Two-Color Letterheads, $2.05. Samples Free. Printshop, 1915 S. Kedzie, Chicago.

100 Bond Letterheads and Envelopes, $1.25 Postpaid. Garland Miller, Trimble, Ohio.

1000 Letterheads, Envelopes, Typewriter Letters, $2. Circulars, Labels, $1; samples. M. Lemond, 65 Broadway, Brooklyn, N. Y.

100 Engraved style visiting cards, 50c.; 100 emblem cards, 70c. H. Gregory, Warwick, N. Y.

Attractive Gummed Labels Samples Free! Edward Harrison, "Guaranteed Printing," Baltimore.

Miscellaneous

For Sale. Choice Silver Black breeding foxes. Reid Bros., Bothwell, Ont., Canada.

Steam-No-More for eyeglasses and auto-windshields. Send ten cents for twenty-five cent sample. Gray's Sales Agency, Port Huron, Michigan, Dept. J.

Mansfield's Automatic water and oil finder a proved success, silver medal awarded. Particulars from Edwin A. Mansfield & Co., 94 Victoria Road, New Brighton, England.

Shoes for Everybody at reasonable prices. Save money and send for free descriptive circulars. Central Sales Co., 599 Ninth Ave., New York.

Wanted. Small Gasoline and Steam Engines, Small Lathes, Drill Presses and other light machinery. Will pay high cash prices for good material. Johnston, West End, Pittsburgh, Pa.

Patent Attorneys.

Patents—My fee payable in monthly installments. Send sketch for advice. Booklet free. Frank Fuller, Washington, D. C.

Millions spent annually for ideas! Hundreds now wanted! Patent yours and profit! Write today for free books—tell how to protect yourself, how to invent, ideas wanted, how we help you sell, etc. 212 Patent Dept., American Industries, Inc., Washington, D. C.

Patents Procured, Trade Marks Registered. A comprehensive, experienced, prompt service for the protection and development of your ideas. Preliminary advice gladly furnished without charge. Booklet of information and form for disclosing idea free on request. Richard B. Owen, 130 Owen Bldg., Washington, D. C., or 2278-T Woolworth Bldg., New York.

Inventors. Send sketch of your invention for advice regarding patent protection. Twenty years' experience. Handbook on patents sent Free. Talbert & Talbert, Patent Lawyers, 4822 Talbert Bldg., Washington, D. C.

John M. McLachlen, Atty. at Law, Patents, Trade Marks, Copyrights, 410 McLachlen Bldg., Washington, D. C.

M. F. Miller, Ouray Building, Washington, D. C., Patent Attorney, Mechanical and Electrical Expert. Best quality of work and results. Moderate charges. Advice free.

Patents. Foremost word free. Write now. Metzger, Washington, D. C.

Patent Attorney. Electrical engineer, mechanical expert; thorough personal service. Frank Ledermann, 21 Park Row, New York.

Patent Your Own Inventions. Save attorney's fees; we prepare applications; furnish full instructions and give satisfaction. Free information. Carl Larsen Co., Park Row Bldg., New York City.

Inventors' Adviser. Sent free on request. Wm. C. Linton, 918 F St., N.W., Washington, D. C., 363 University St, Montreal, Canada.

Patents promptly procured by personal expert service. Information on request. James D. Lyles, Washington, D. C.

Patents. Prompt, personal efficient service by an Attorney-at-law skilled in all branches of Patent practice. Over 12 years' actual experience, full information upon request. B. P. Fishburne, 324 McGill Bldg., Washington, D. C.

Phonographs and Supplies.

Build Your Phonograph. "Perfection" high-quality spring and electric motors, tone arms, reproducers. Wonderful results. Big saving. New catalog and building instructions mailed for ten cents. Indiana Phonograph Supply Co., Indianapolis, Ind.

Build Your Own Phonograph and manufacture them for profit. Drawing instructions, parts, price list, blueprints, etc., complete, sent free upon request. Write today. Associated Phonograph Co., Dept. E-1, Cincinnati, Ohio.

Make Your Own Phonograph. Particulars free. DeSelO-PhonE, P. O. Box 720, Attica, Indiana.

GREATEST TOY SENSATION OF THE DAY!

FIGHTING DREADNAUGHT

SENSATIONALLY REALISTIC!!!

Here is a model of Uncle Sam's fighting monsters. Eight big guns, each of which flashes, at correct intervals, from twelve to twenty times. Extra ammunition always obtainable. Absolutely harmless. Can be operated indoors or out. Now boys! Here's your chance to see a battleship in action, and the best of it is you can OWN the ship and command the firin yourself! By having two or more Battleships, you can arrang EXCITING NAVAL BATTLES in your own home. **Price c Warships and Ammunition, 15c, three for 40c, or a fleet of 5 ships for $1.50 postpaid. Extra Ammunition, 5 cents per pkg**

TOOTH-ACHE STOP

EASY TO USE

Stops the Pain; Stops the Tooth

Squeeze a little in hollow of tooth; the Ache Stops instantly the paste hardens, forming an antiseptic Filling. Absolutely harmless. Have it ready for the next bad attack. **25c per tube, postpaid.**

"SAFETY 1st" PINS

A clever novelty. The National Safety First Movement has made them very popular. Wear one and show your sympathy with the movement. Also handy for wearing at automobile theatricals and the like. Two sizes, ½ in. (gold plated) and 1⅜ in. (nickel-plated) 6c each, two for 10c p. pd.

Mysterious Ghost

This is not a pretty object, but there is fun in it for people who like practical jokes. The ghost, when displayed in a perfectly dark place, glows with a ghastly cold bluish radiance, very apt to give one a "creepy" sensation, even when you know all about it, but a regular startler for those who come upon it unexpectedly. A great joke to play on your mother-in-law. Price only 15 cents each, or three for 40 cents.

INKLESS PEN

WRITES with WATER 500 words at one time you dip. Makes its own ink. Writes fashionable violet color. Better and cheaper than fountain pens. Writes a long letter with one dip in plain water. No trouble—no bother—no muss. A pleasure to use. With Nickel Plated Reverible Holder 10 CENTS. 5 for 25c

SIMPLEX TYPEWRITER ONLY $2.50

Cheap But Good. So Simple a Child Can Use It. We Guarantee the Writing.

Though so marvelously cheap, this machine is a thoroughly practical Typewriter. We positively guarantee it to produce writing as neat and even as that of the highest priced machine. It does not seem possible at the price, but let us send you a specimen of its work and you will be convinced. With every machine we give it will last a long time. It is so simple that a child just able to read can write with it. You can learn all there is to know about it in five minutes, and an hour's practice will make you an expert operator. Every business man must have a typewriter. Illegible pen writing is unbusinesslike and creates the impression that the firm is a poor account and slow-going concern. We assure you that the Simplex Typewriter fully deserves its name as it is fit to do the correspondence of any business or profession, and to do it well. You should not miss this chance of securing a bargain. The letters of the alphabet, the numerals 1 to 10, and punctuation marks are so grouped that the letters most used are before the operator most of the time, enabling him to write rapidly. The rollers hold the paper in posit n while writing and at the end of each line a slight turn of the roller moves the rachet which makes a click and forces the line or paper line one space forward, giving the operator the proper line spacing, so that the lines are all an equal distance from each other, so desirable in letter writing. Each typewriter packed in a strong box, with full printed instructions for use. Price complete, $2.50 sent by mail postpaid.

Johnson Smith & Co., Dept. E11, 3224 N. Halsted St., Chicago

SQUIRT RING

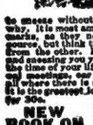
You may have a lot of fun with this Sparkling Gem Squirt Ring. It consists of a handsome 5-plate ring attached to a rubber ball, so arranged that the latter is quite out of view when the ring is in the proper position. Such an attractive looking ring as this cannot fail to be the center of attraction. While the victim is absorbed in getting a better view, you just squeeze the rubber ball and the observer experiences a very great surprise. **PRICE** only 10c, three for 25c or 50 on a postpaid. J. S. & CO

Wonderful X-Ray Tube

A wonderful little instrument producing optical illusions both surprising and startling. With it you can see what is apparent, the bones of your fingers. Encased in a lead pencil, the interior opening is a pipe stem, and many other similar illusions. A mystery that no one has been able to satisfactorily explain.

Price 10 cents; 3 for 25 cents; 1 dozen, 75 cents. Sent by mail, postpaid.

Sneezing Powder



Place a very small amount of this powder on the back of your hand and blow it into the air, and everyone in the room or car will begin to sneeze without knowing the reason why. It is most amusing to hear their remarks, as they never suspect the real source, but think they have caught it from the other. Between the laughing and sneezing everyone will be kept busy the time of your life. For parties, political meetings, car rides or any place at all where there is a gathering of people, it is the greatest joke ever. Price 12c per box, 3 for 25c, 12 for $1.00, 50 for $3.50, 100 for $6.00. **Agents Wanted. Dozen Lots Only for $3.00.**

STAGE MONEY

With a bunch of these bills, it is easy for each person of limited means to appear prosperous. By flashing a roll of this money at the proper time, and paying off a genuine bill or two from the outside of the roll, the trick will be found to be all that can be desired. Dozen packets, 10 cents; 100 bills 25c, 125 for $1.00, 250 for $1.50 thousand

NEW BOOK ON ROPE SPLICING

USEFUL KNOTS, HITCHES, SPLICES, ETC.

How Different Knots Are Made and What They Are Used For. Knots to Use and Knots to Avoid.

A most practical handbook giving complete and simple direction for making all the most useful knots, hitches, rigging, splices, etc. Over 100 illustrations. All about wire rope attachments, lashing, blocks, tackles, etc. 87 Heraldic Knots illustrated. Of great value to mechanics, riggers, campers, boatsmen. Price 20c p. pd.

Johnson Smith & Co., Dept. E11, CHICAGO

LUMINOUS PAINT

Make Your Watches, Clocks, Etc., Visible by Night The very latest discovery in the scientific world. Hitherto, practically unobtainable except at an enormous cost, we have at last succeeded in producing this remarkable LUMINOUS PAINT. It is put up in bottles containing enough to cover a space of white paper measuring 2 inches square, and will be visible in the dark. **THE DARKER THE NIGHT, THE MORE BRILLIANT IT SHINES.** It is absolutely harmless and simple to use. Anyone—you can do it. A little applied to the dial of your watch or clock will enable you to tell the time by night. You can paint the buttons or switch plates of your electric lights, switch boxes, and innumerable other articles; make up your own Luminous Ornaments. A sufficient bottle containing sufficient to coat several small articles. Price, 25c. Larger sizes 50c and $1 postpaid. Johnson Smith & Co., Dept. E11

MUSICAL KAZOO

With the Musical Kazoo you can, without previous practice, play any tune right off, imitating any bird or animal, also imitate snare drum, Punch and Judy, etc. No book to study. It is simplicity itself. Produces excellent music. You do not blow into, but sing into the instrument and make any desired imitation. Used with astonishing results at society meetings, picnics, clubs or church entertainments, dances, serenades, parties, with the orchestra. Just the thing for choruses and shows, bicycle and marching clubs, etc. Excellent for vocal or instrumental accompaniments, either with or without other musical instruments. Price 15c. ea.

MAGIC FLUTE

Wonderfully Sweet Toned and Musical Automatic Musical Instrument

It fits the mouth like the bottom of a quick lunch house—in fact, any glass of reasonable size can be played upon the figure, the tone without practice, as it is almost a self-playing instrument. When played with a piano accompaniment, or any other musical instrument, the effect is charming. Full printed instructions for playing sent with each instrument.

Post Paid **15c**

All the Latest Surprising and Joke Novelties

Flame's Serpents Eggs, box . .	10c
Miniature Writing Pencil . . .	10c
Sleepers's Snake (very lifelike) .	5c
Snake Joke Cigarettes (fool friends)	10c
Fake Asbo Pencils (Lifelike) . .	10c
Mysterious Ghost, shines at night	10c
Rubber Vampire (very convincing) .	10c
Rubber Dagger (apparently real) .	10c
Rubber Snake (coiled joke) . .	10c
Jack-in-the-box (one behind you)	10c
Ghost Hiding Behind Post . . .	10c
Professor's Mysterious Nest Eggs .	10c
Fighting Roosters, pair	10c
Cover the Spot Trick, a nelson, new.	10c
X Ray Revealing	10c
Trick Pencil	10c
Rubber Tacks (a good joke) . .	10c
Memorized Penny (defies the law of gravitation)	20c
Mysterious Vanisher and Vanishing Coin Trick	50c
Magic Mirror (take one peep) . .	10c
Magic Egg	10c
Imitation Gold Teeth	5 for 10c
Sweet Surprise Candy	10c
Wire Puzzles, 10c. 25 different, $1.00	

JOHNSON SMITH & CO., Dept. E11, 3224, N. Halsted St. CHICAGO

Boys, you can have Movies at your own home with this latest model

MOVING PICTURE MACHINE

Uses Standard Films, same as the larger machines. Very easily managed. Simply turn the handle. Good Variety of Films always obtainable

PRICE Complete ONLY **$2.65** Postage 15c. extra Including Film.

Extra Films, 15c each postpaid

THIS IS A GENUINE MOVING PICTURE MACHINE and the motion pictures are clear, sharp and distinct. The Moving Picture Machine is finely constructed, and carefully put together by skilled workmen. It is made of Russian Metal, has a beautiful finish, and is operated by a finely constructed mechanism. The projecting lenses are carefully ground and adjusted, triple polished, standard double extra reflector, throwing a ray of light many feet, and enlarging the picture on the screen up to three or four feet in area. The light is produced by a safety carbide generator, such as is used on the largest automobiles. This throws a dazzling white light on the screen.

It is a solidly constructed and durable Moving Picture Machine. The mechanism is exceedingly simple and is readily operated by the most inexperienced. The pictures shown by this marvelous Moving Picture Machine are not the common, crude and lifeless Magic Lantern variety, but are life-like photographic reproductions of actual scenes, places, and people which never tire its audiences. This Moving Picture Machine has caused a rousing enthusiasm wherever it was used.

JOHNSON SMITH & CO.

Dept. E 11 3224 N. HALSTED ST., CHICAGO

ANARCHIST BOMBS

Consists of a little glass vial, containing in liquid form a chemical which will produce a most horrible odor. One dropped in a room full of people will cause more consternation than a literary theorem. The smell will entirely disappear in a short time. 3 Boxes for 25c, shipped by express only with a Dollar's worth of other merchandise.

ITCHING POWDER

This is another good practical joke; the intense discomfiture of your victims to every appearance themselves is thoroughly enjoyable. All that is necessary to start the ball rolling is to deposit a little of the powder on a person's hand and the performer can be relied upon to do the rest. The result is a vigorous scratch, then some more scratch, and still some more. 3 Boxes for 25c. Sent only by express. (Must order at least One Dollar's worth of other merchandise.)

INVISIBLE INK

The most confidential messages can be written with this ink, for the writing **MAKES NO MARK.** Cannot be seen unless you know the secret. Invaluable for many reasons. Keep your postals and other private matters from prying eyes. Great fun for parties. A practical joke. **One 15c Bottle**

LOVE LETTER INK

Writing written with this remarkable ink vanishes entirely in a few weeks (sooner if desired), leaving the paper QUITE BLANK. 15c p. pd.

LUMINOUS INK Writing can be READ ONLY IN DARK by writing with this ink. Very remarkable. 15c per bottle, postpaid.

MULTIPLYING BILLIARD BALLS

The Best Feat of Its Kind

This trick is as effective as it is surprising. The performer hands around the ball for examination, and immediately it is returned to him he seizes it by the tips of his fingers and fingers and a second ball mysteriously appears. These are then passed around for inspection by the tips of the fingers of the left hand, and even while being placed in position, another ball unexpectedly makes its appearance. Now the magician apparently suffers from some kind of spasm and yet another ball is the result. The feat can then be repeated, the balls disappearing one after another until none remains. It is a very interesting trick that is quite easily performed by following the directions that accompany the apparatus. **PRICE, 25 CENTS. POSTPAID.** JOHNSON SMITH & CO.

GOOD LUCK RING

Quaint and Novel Design

A VERY striking and uncommon ring, made of gunmetal. The quaint and fierce design with two brilliant eyes, and the sparkling out of the eyes, never fail to attract attention. It is said by many to bring Good Luck to the wearer, hence the name used. Lush Ring, a id whilst you will not positively guarantee that, it is certainly a unique ring that you will take a pride in wearing. They were made to sell at 50 cents, but as a special bargain we will supply them to customers mentioning this paper, at HALF PRICE, or ONE DOLLAR, POSTPAID. JOHNSON SMITH & CO. **25 CENTS.**

LOADED CIGARETTES

Just Like Ordinary Cigarettes, But Each Reel Is Loaded

A box containing ten apparently genuine Cigarettes. They contain a ball which explodes when about one-third is smoked.

They appear so real, and afford an excellent joke on the victim, as he or she is taken entirely by surprise. It is very harmless. Price, box of ten, 10 cents; dozen boxes, 75 cents.

Johnson Smith & Co., Dept. E11

THE "LITTLE GIANT" TYPEWRITER

A First Class Writing Machine For $1.25

A pen act little typewriter for $1.25 Prices are thousands of percent less than you have to use a typewriter but the same needs and business do not warrant the expense added to the purchase and use of a fifty or seventy-five dollar machine. To such persons we recommend our Little Giant. It is strongly made, but simple in construction, so that any one can quickly learn to operate it and write as rapidly as they would with a pen. A letter of the alphabet most frequent y used being so grouped as to enable you to write rapidly, the numerals, 1 to 10, and the punctuation marks being together. With this machine you can send your best girl typewrit ten love letters, address envelopes, make out bills, and do a great any kind of work not requiring a high priced machine. With each typewriter we send a tube of ink and full printed instructions for the use of the machine. Price complete with 24 inch carriage or 12 inch, $1.25 postpaid. Johnson Smith & Co.

SERPENT'S EGGS

Each box contains 12 Eggs, which are no larger than a grain of oats. When lit with a match, however, each one gradually hatches itself into a Snake several feet long, which curls and twists about in a most lifelike manner. **Price per box 10c, postpaid. Johnson Smith & Co.**

MYSTIC SKELETON

A jointed figure of a skeleton 14 inches in length. Will dance to music and perform various gyrations and movements while the operator may be any distance from it. The figure may be operated by fine cotton thread. When handed back to the operator it is simply placed on a chair or table, when it will seemingly become endowed with life, and begin to dance. At the command of the operator it will sit down, stand up, dance, etc. We send full direction with each Skeleton by the use of which anyone can readily make it perform. 10c postpaid.

CIGARETTE ROLLER

Very neat and handy. Weighs less than a quarter of an ounce. It makes better cigarettes than you can buy and makes them easily and quickly. You can use just the tobacco you prefer and thus have all the "smokes" made, and more of them besides saving about half of your money. Just try one and make your cigarettes just to your own liking. Price only 10c, or 2 for 25c postpaid, with full instructions for use. JOHNSON SMITH & CO.

MIDGET ILLUSTRATED BIBLE

A Great Curiosity

The Smallest Bible in the World

The Midget Bible is a perfect gem, and a work of art. It is the size of a postage stamp and contains the OLD AND NEW TESTAMENTS, DIVIDED AND FIFTY-TWO BOOKS, profusely illustrated. This little Bible is a wonderful curiosity, and will bring good luck to the owner. Must be seen to be appreciated. Price, only 12 cents. Bibles for 30 cents; one dozen Bibles for $1.00 or 100 for $6.00. Good money can be made selling these Midget Bibles amongst friends, church acquaintances, Sunday schools, bazaars, etc. Send for a few and try it.

The CONJURER'S CASKET

Apparatus and Directions for a Number of Mysterious Tricks Enough for an Entire Evening's Entertainment

ANYONE CAN DO THEM **50c**

It is great fun mystifying your friends. Get this Conjurer's Casket, and you will be the cleverest fellow in your district. It contains the most wonderful first-rate tricks, including the Vanishing Handkerchief, that, when played on the hand of a person, vanishes from sight at will; the Magic Vase and Ball Trick; a Wooden Ball is placed in a solid wooden bowl, and by the performer's command is found in someone else's pocket; The Magic Nail with which you can perform many startling tricks; The Wonderful Card Trick (a card is placed in an envelope, and when opened an entirely different card appears); Disappearing Coin Box (a coin is placed in the little wooden barrel, and when opened again, is found to have vanished entirely, or can be made to change from one to the other); The Vanishing Coin Trick (shows the law of gravitation suspends from the palm of the hand, nose, cheek, wall, clothing, etc.); The Glass Bowl and Vanishing Coin Trick (a coin is dropped into a glass of water, and when the water is poured out the coin has vanished). With the seven tricks described above we send full printed instructions for performing each trick, so that anyone can perform all the tricks to the great amusement of their friends or the public. Any boy of ordinary intelligence with this Cabinet of Tricks in his possession, can give a parlor entertainment not inferior to some regular magicians. Besides the tricks contained in the Cabinet, there are twenty-five other tricks and illusions fully explained with full printed instructions, for which you can easily make or procure the necessary apparatus. Among these are The Dancing Pea, The Drawn Card, The Hat Trick, To Knock a Tumbler Through a Table, One Cent Rubbed into Two, To Find the Number Thought of, Mysterious Wedding Ring etc. We also send the secret of performing three wonderful stage tricks, as follows: The Act of Growing a Woman, Walking on the Ceiling of a Room, and the Disappearing Lady, together with an article on entertainments and valuable hints to amateur conjurers. **PRICE COMPLETE ONLY 50 CENTS.**

JOHNSON SMITH & CO., Dept. E11, 3224 N. Halsted Street, CHICAGO

The Newest Novelty Aerial Balloon

Flies anywhere it is thrown. This is the VERY LATEST SENSATION IN BALLOONS. A realistic toy balloon, measuring sixteen inches long is blown up in the usual way, and when released it flies around the room, SOARING UPWARD, the air-jack propeller SPINNING AROUND AT A TREMENDOUS RATE OF SPEED. Then it comes LIVELY BACK. The effect is startling. It is a graceful flier that makes the youngsters simply wild with delight. May be used repeatedly indoors or outdoors. An immensely interesting toy. Price 10c each, 3 for 25c post.

JOHNSON SMITH & CO., Dept. E11, 3224 N. Halsted Street, CHICAGO

"The Baby" Double Action Hammerless Revolver

A HANDSOME AND MOST EFFECTIVE WEAPON

$6.50

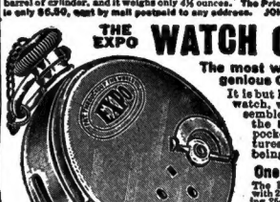
Measures but 4¼ inches long

Takes regular .22 caliber cartridges

The new Baby Double Action Hammerless Revolver has been produced to meet the ever increasing demand for a revolver that would combine small size and light weight with the essential features of Effectiveness and Practicability. It is small in size, yet is just as effective and serviceable as the most expensive weapon you can get. Every lady should have a revolver and should learn to use it and there is no safer or better one made than this. A great feature is its safety action that prevents accidental discharge, making it quite safe for young men and ladies. The illustration gives an idea of its appearance, but its compactness and used to be thoroughly appreciated. The ammunition used is the standard, 22 caliber rim fire cartridge obtainable anywhere. you may also send the cartridges from us (cartridges can be shipped only by express). The revolver has six shots in one loading. The operation of the charging and ex- tremely rapid and absolutely reliable; six well aimed shots can be fired in as many seconds. The revolver is very well constructed, with finest nickel plated fluted barrel of cylinder, and it weighs only 4½ ounces. The Price of the Baby Revolver is only $6.50, cash by mail postpaid to any address. JOHNSON SMITH & CO.

THE EXPO WATCH CAMERA

The most wonderful and ingenious Camera made



It is but little larger than a watch, which it closely resembles. You can carry the Expo about in your pocket and take pictures without any one being the wiser.

One Cent a Picture

The Expo loads in daylight with 25 Exposure Films, costing 25c; thus the picture taking part of a whole day's outing may be had for the nominal sum of 25c—One cent a picture. 15 Exposure Films also obtainable. It's simplicity itself to operate. Takes pictures through the stem, where the Range Finder is located. The photos (5/8 x 1 1/8) may be enlarged to any size.

Price $2.50

QUICK AS A FLASH

Time and Instantaneous shutters; weighs but 8 ounces; nickel plated. Endorsed by amateurs and professionals the world over. Thoroughly satisfactory printing and developing of films just the same as ordinary cameras. Can be used by the police, newspaper reporters, detectives, and the general public. Important scenes have been successfully taken with the Watch Camera by secret service. Produces clear, sharp negatives indoors or outdoors equal to any camera on the market, size or price notwithstanding.

Expo Watch Camera Postage 10c Anywhere $2.50 FILMS, 10 Exposure 15c, 25 Exposures, 25c Leather Pocket Carrying Case, 35c

Johnson Smith & Co., Dept. E11, 3224 N. Halsted St., Chicago

BOYS!

Would you like to earn one of these magnificent Bicycles absolutely without costing you one cent? FREE!

HUNDREDS OF OTHER EXPENSIVE PRESENTS ALSO GIVEN

We have secured an enormous quantity of very beautiful colored pictures, consisting of art, floral, landscape, religious, patriotic, etc, and are going to sell them at less than half their value. Many stores would charge from 25 to 50 cents each for them, but a very fortunate purchase permits us to sell them at the astonishingly low price of 10 cents each, at which price they are irresistible, and will certainly go fast

Now all you have to do is to send us your name and address and we will send you 15 of these beautiful pictures, without any charge whatsoever. These pictures you are to sell at 10 cents each. When sold, send us the money, and we will send you goods OF YOUR OWN SELECTION from our 300 page catalog to the value of $2.50. Remember, you get these goods as a premium for selling the pictures and sending us the money. You don't have to pay a cent for them. Many of our agents have sold the whole 25 pictures in one day, some have sold them in the evening. One agent sold six on the way home from the post office, another sold some before he got out of the post office. Another agent sold the entire lot to one lady. People are wild to get these pictures once they see them, and you will have no difficulty in disposing of them if you will only show them.

Remember, you have our entire catalog to select your premiums from, and there are hundreds of presents such as Air Rifles, Guns, Moving Picture Machine, Musical Instruments, Cameras, Printing Presses, Typewriters, Books, Puzzles, Games, Tricks, Toys and Novelties, rubber stamps, household labor-saving devices, etc., and we are sure you would like to get many of them, especially if you can do so without having to pay any money for them.

By continuing the sale of our pictures you can earn the magnificent Bicycle illustrated. We will give you presents of equal value to the pictures you sell. Send in your application at once, and we will send you the first lot of pictures immediately, accompanied by our big catalog of over a thousand different articles to select your premiums from. You don't have to send any money. We trust you absolutely.

JOHNSON SMITH & CO., Dept. E 11, 3224 N. Halsted St., CHICAGO

New Vamping Card

No Teacher Needed Surprisingly Simple System

Persons having completed their Musical Education need not despair, for with the aid of our new VAMPING CARD (placing the card upon the piano keyboard) you can at once Vamp away to thousands of Songs, Ballads, Waltzes, Rag Times, etc., equal to a Professional Musician. No knowledge of music is required. After using it a few times, you will be able to dispense with the aid of the Vamping Card entirely. Only 15 cts. p. pd. Johnson Smith & Co., Dept. E11

SHARPEN-M-ALL SAFETY RAZOR STROPPER

SHARPENS EVERY KIND OF SAFETY RAZOR BLADE

Sharpens the Gillette and Durham Duplex both edges at one time

ALSO SHARPENS THE GEM JUNIOR, EVER READY, KEEN-KUTTER, MARK CROSS, CLARK, AUTO-STROP, STAR CRUSSTEEL, AND ALL OTHER MAKES

By using the SHARPEN-M-ALL STROPPER, you will not only get BETTER SHAVES, but you will SAVE MONEY, as one blade can be made to get from 150 to 200 shaves from one blade, and the last shave will be as good as the first. The construction is simple and will last a lifetime. There are no parts that can get out of order Any novice can use it just as well as the most expert barber. It is operated by simply turning the lever or handle as shown in the illustration It has two sets of strops, one on each side of the pivot as they are revolved, giving the CORRECT DIAGONAL STROKE. It requires no adjustments, or any kind of tinkering necessary to operate it. It is made of hardwood, and a special material that STROP AND HONE the blade at the same time. The rollers turn only one way, so there is no fear of damaging the blade or the stropper. The SHARPEN-M-ALL is packed in a handsome case, 6x2 1/2x1 1/2 in., with three holders and full instructions The weight of the complete machine is but eight ounces Price, only $1.50, postpaid.

JOHNSON SMITH & CO., DEPT E11 3224 N. HALSTED STREET CHICAGO

Potmend *Stops a leak in a minute*

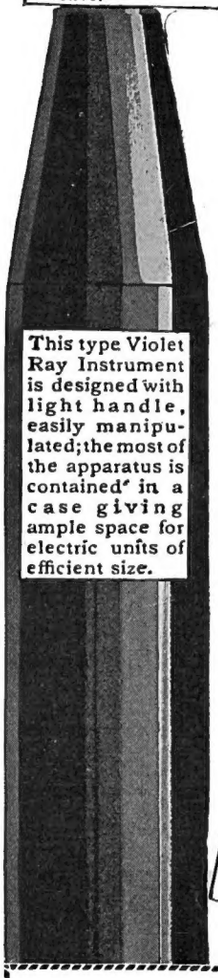
The finest repairer for Ironware, Agateware, Enamelware, etc. Good for kettles, pots, pans, boilers, and every kind of Ironware, also for tin, copper, aluminum, ice boxes, iron pipes, cracks in stoves, broken chins, porcelain, pots-a-brae, bisque, crockery, woodenware, marble, etc. Will not chip, burn, bake or boil out. **THE MEND IS THE STRONGEST SPOT IN THE POT.** Could not be broken just quit the powders with water. HARDENS LIKE IRON. Fire-proof, Water-proof. You can fill a big hole or a small crack. Simple as A B C. Beginners succeed at first trial. Anyone can do it. FAILURE IS IMPOSSIBLE. Better and easier than solder. Three sizes, 15 cents, 25 cents and 50 cents.

Johnson Smith & Co., Dept. E11 3224 N. Halsted St., Chicago

Regain Your Health Thru Renulife VIOLET RAY Treatments at Home

Unequaled for neuritis and rheumatism

More Than 25,000 Volts No pain, shock or muscular contracuon. Entirely harmless — powerfully effective.



This type Violet Ray Instrument is designed with light handle, easily manipulated; the most of the apparatus is contained in a case giving ample space for electric units of efficient size.

There is no "quackery" or uncertainty about *Renulife Violet Ray*. It is not claimed to be a "Cure All," but it has proved in thousands of cases a practical health-producing, revitalizing agent—powerful in restoring normal physical conditions—yet gentle, soothing and perfectly safe. *You* can treat yourself. Get full information regarding uses shown on coupon below.

Users Get Wonderful Results

(Voluntary Testimonials)

"The Renulife Violet Ray High Frequency Generator is superior in efficiency because of its perfect character and control of current, compactness and perfect insulation. The smallness and lightness of Electrode holder is also a great advantage." "The doctor told me that the trouble was hardening of the arteries. I wish I had got it a year ago. I would not be without it for all the money in the world." "I cannot recommend it too highly." "I have been using mine now for a week for Sciatica and I am highly pleased with results." "I think it is one of the best little machines that was ever invented." "I have used it with excellent results for the restoration of hair and stiff and sore rheumatic finger joints." "Am well pleased with the Generator, and the kind treatment received from your Company." "My Generator has stopped my neuritis." "Every house should have a Renulife Violet Ray High Frequency Generator, for the treatment of Neuralgia, Neuritis, Sore Throat, Kernels in Neck, Cramps, Headache, Stiff Neck, Muscular Soreness, Rheumatism, Paralysis—in short, pains of all kinds."—M. D. "I have been much relieved by the use of your Violet Ray Generator." "It is fine for Insomnia." "I find it such a help in nervousness." "I would not part with it for five times the price. It is sure a little wonder." "I am more than pleased with the Generator; the whole family are using it." "A neighbor lady was suffering from lumbago and could not move, and my wife brought over the Generator and in less than ten minutes the lady was greatly relieved." "Your Generator is just the thing for me. That tired feeling has left me, and I feel like myself again." "It has relieved me of the nervousness and also it has helped me a great deal in using it for the treatment of rheumatism."

How Renulife Benefits

Science has demonstrated a strange relation between electricity and life cells. This instrument harnesses a tremendous current of electricity and applies in the form of Violet Rays so that the body welcomes and responds to it in a marvelous manner—no pain—shock or the slightest harmful effects. A few seconds of Renulife Violet Ray gives more benefit than hours of the old time battery methods—because a thousand times as much voltage is made use of.

The irresistible, revitalizing powers of *Renulife Violet Ray* reach every nerve cell, fibre and part of body. Blood is enriched and purified by a flood of oxygen, giving added vitality and strength. Assimilation and digestion improved—functions retored to normal—extra supply of fresh blood quickly brought to area treated, removing congestion and supplying nourishment. While relieving pains and aches, the manifest results of disorders, it removes the deep seated cause, combines the benefits of electricity, vibration, exercise, stimulation and oxidation.

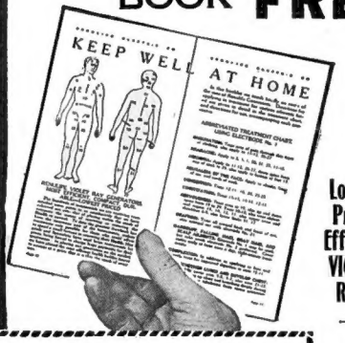
Get Book "Health via Violet Ray"

Learn the whole marvelous story of the Violet Ray—this method that works with nature to restore and build up. Learn how you, at home, can now use these great curative forces of Violet Ray—heretofore only available at big expense from physicians or beauty doctors. Send coupon or postal card now and receive free book describing uses, quoting low prices (within the reach of all) and explaining liberal *Trial Plan*.

Renulife Electric Co., Inc.
1209 Marquette Bldg., Detroit, Mich.

CANADIAN RENULIFE ELECTRIC CO., Ltd.,
1209 Netting Bldg., Windsor, Ont.
Toronto Office: 612 C. P. R. Building.

Live Sales Representatives write for proposition



BOOK **FREE**

Increases energy and vitality

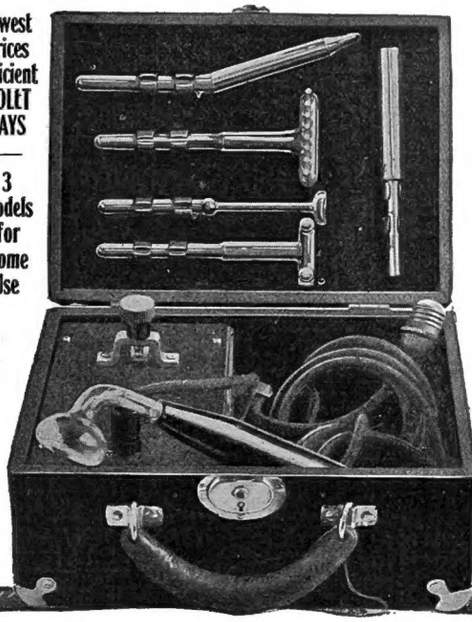
Treatment for nervousness and general debility

Ozone most beneficial for catarrh, throat and lungs. Also anemia

Stops falling hair — promotes hair growth. Wonderful beauty aid

Lowest Prices Efficient VIOLET RAYS

3 Models for Home Use



COUPON FOR BOOK and Special Information

RENULIFE ELECTRIC CO.,
1209 Marquette Bldg., Detroit, Mich.

Please send without obligation, your book "Health," explaining Violet Ray treatments with Renulife Generators; also give full particulars as to its application for ailments checked below.

TREATS SUCCESSFULLY

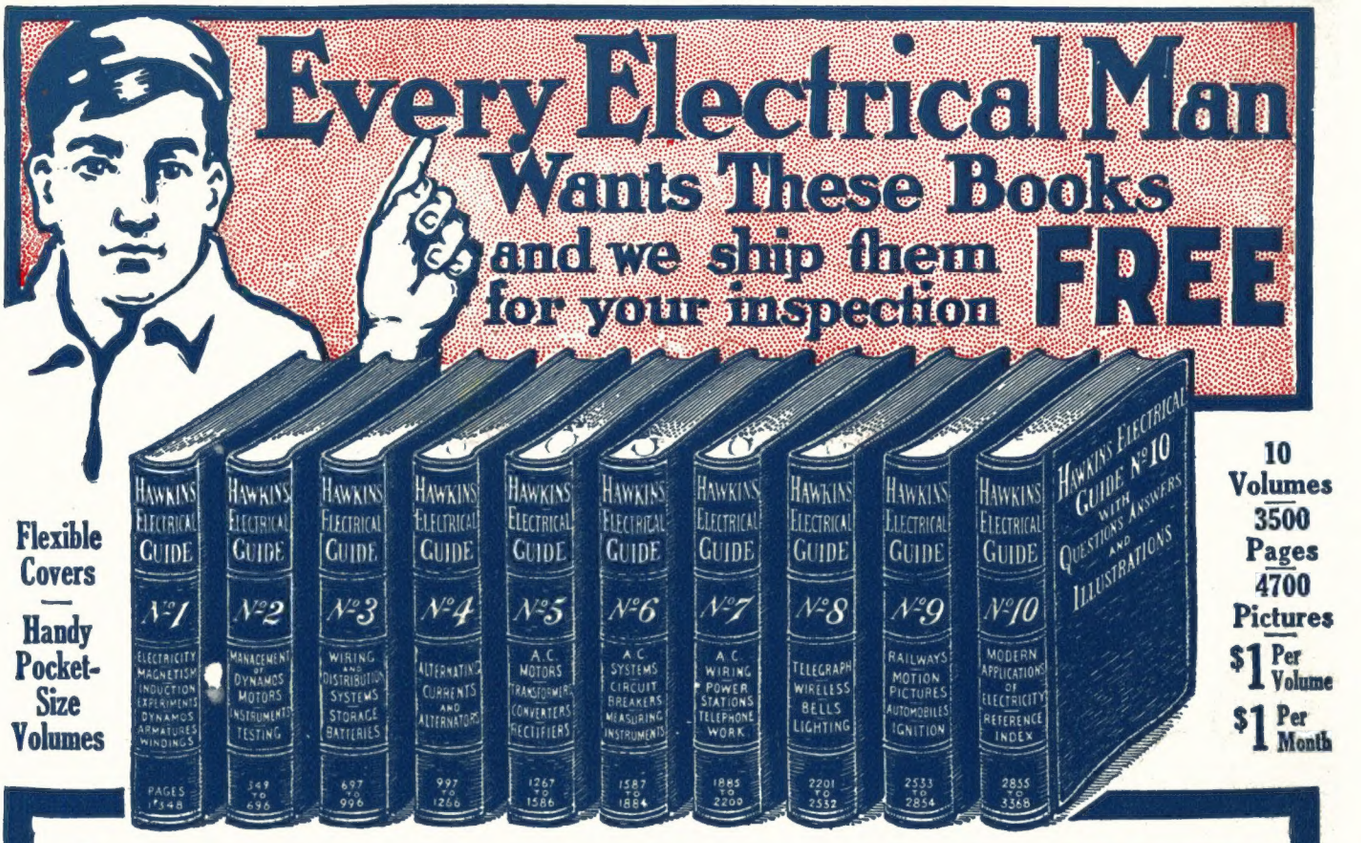
..Abscesses	..Facial Neuralgia	..Piles
..Anemia	..Falling Hair	..Pimples
..Asthma	..Goitre	..Pyorrhea
..Arteriosclerosis	..Gout	..Rheumatism
..Baldness	..Hay Fever	..Scars
..Blackheads	..Infantile Paralysis	..Sciatica
..Brain Fag	..Insomnia	..Skin Diseases
..Catarrh	..Lameness	..Throat Diseases
..Colds	..Locomotor Ataxia	..Sprains
..Chilblains	..Lumbago	..Toothache
..Dandruff	..Nervous Affections	..Weak Eyes
..Deafness	..Neuralgia	..Wrinkles
..Eczema	..Neuritis	..Warts and Moles
..Enlarged Prostate	..Paralysis	

Write your name and address in margin below and cut out with coupon

Chicago Office
Room 410
123 West Madison

Copyright, 1919, R. E. Co.

Every Electrical Man Wants These Books and we ship them for your inspection FREE


HAWKINS ELECTRICAL GUIDE Nº1
HAWKINS ELECTRICAL GUIDE Nº2
HAWKINS ELECTRICAL GUIDE Nº3
HAWKINS ELECTRICAL GUIDE Nº4
HAWKINS ELECTRICAL GUIDE Nº5
HAWKINS ELECTRICAL GUIDE Nº6
HAWKINS ELECTRICAL GUIDE Nº7
HAWKINS ELECTRICAL GUIDE Nº8
HAWKINS ELECTRICAL GUIDE Nº9
HAWKINS ELECTRICAL GUIDE Nº10
HAWKINS ELECTRICAL GUIDE Nº10 WITH QUESTIONS ANSWERS AND ILLUSTRATIONS

Flexible Covers — Handy Pocket-Size Volumes

10 Volumes 3500 Pages 4700 Pictures

$1 Per Volume

$1 Per Month

Just what you need to know to succeed in ELECTRICITY

EVERY electrician, every engineer, every mechanic should know about these wonderfully helpful instructive books, which give in plain words a complete working knowledge of electrical engineering in all its phases.

You run into some new electrical problem almost every day. The information you need to help you in your every day work is in

HAWKINS ELECTRICAL GUIDES

These books place electricity at your finger ends. They cover every imaginable subject, principle, theory, problem, trouble, and way of doing things electrically. Every subject is indexed so that you can turn right to it. They are a study course and a reference guide in one, written in plain every day language—no wasted words—only what you need to know—chock full of up-to-the-minute electrical knowledge. The guides are a complete course in electrical engineering. They will help you in every detail of the day's electrical work. You can't ask an electrical question that Hawkins Guides can't answer.

What Electrical Men Say

Helped Him Make Good

"It is only right for me to recommend highly the Hawkins Guides, for they have been of the greatest assistance to me in placing me in my present position as Superintendent of Construction Department of one of Ohio's largest Electrical Companies. I would like to see every man have a set of Hawkins Guides."
Geo. Knecht, Columbus, Ohio.

In the Naval Electrical Dept.

"The Hawkins Guides are great help to me in the Naval Electrical Department, which they cover very thoroughly." C. J. Cornell, U. S. Receiving Ship, Brooklyn, N. Y.

Superintendent

"I am now superintendent of the Dunnville Hydro-Electric Systems, and Hawkins Guides were a great help to me in holding down a responsible position."
W. E. Swartz, Dunnville, Ontario.

Wireless Operators

"I have worked wireless for ten years—but I wish I had these books years ago, as they have saved me a great deal of trouble." H. Marshall, Steamer M & B No. 2, Walkerville, Ont.

Pocket-Size Flexible Covers

The books are small enough to slip into your coat pocket—handsomely bound in flexible black covers.

You can carry each volume with you until you have mastered its contents. 3,500 pages of actual information and 4,700 illustrations. Once you see these books and put them into actual use you will never again want to be without them. Try it at our expense.

SEND NO MONEY

It will cost you nothing to receive these books—to look them over—ask them all the questions you can think of—use them in your work—study them—pick up some information that will increase your earning ability. We will ship you the entire set of 10 volumes entirely FREE.

This is a sign of our confidence in the guides. Pure gold does not object to being tested. Keep them for seven days and if you do not decide that you can't get along without them, return them to us and owe us nothing.

When you decide to keep them you only have to pay $1.00 down and remit the balance of $9.00 on the easy payment of $1.00 a month till paid for.

Use this coupon to get the books. It will pay you many times over.

THEO. AUDEL & CO.
72 Fifth Ave. New York, N. Y.

SEND NO MONEY - USE THE COUPON

READ THIS PARTIAL LIST OF CONTENTS

No. 1 Contains 348 pages, 388 illustrations. Electrical signs and symbols—static and current electricity—primary cells—conductors and insulators—resistance and conductivity—magnetism—induction coils—dynamo principles—classes of dynamos—armatures—windings—commutation—brushes, etc.

No. 2 Contains 348 pages, 394 illustrations. Motor principles—armature reaction—motor starting—calculations—brake horsepower—selection and installation of dynamo and motors—galvanometers—standard cells—current measurement—resistance measurement—voltmeters—wattmeters—watt hour meters—operation of dynamos—operation of motors, etc.

No. 3 Contains 300 pages, 423 illustrations. Distribution systems—wires and wire calculations—inside, outside and underground wiring—sign flashers—lightning protection—rectifiers—storage battery systems, etc.

No. 4 Contains 270 pages, 379 illustrations. Alternating current principles—alternating current diagrams—the power factor—alternator principles—alternator construction—windings, etc.

No. 5 Contains 320 pages, 614 illustrations. A. C. Motors—synchronous and induction motor principles—A. C. commutator motors—induction motors, transformers; losses, construction, connections, tests—converters—rectifiers, etc.

No. 6 Contains 298 pages, 472 illustrations. Alternating current systems—switching devices—circuit breakers—relays—lightning protector apparatus—regulating devices—synchronous condensers—indicating devices—meters—power factor indicators—wave form measurement—switch boards, etc.

No. 7 Contains 316 pages, 379 illustrations. Alternating current, wiring power stations—turbines; management, selection, location, erection, testing, running, care and repair—telephones, etc.

No. 8 Contains 332 pages, 436 illustrations. Telegraph—simultaneous telegraphy and telephony—wireless—electric bells—electric lighting—photometry, etc.

No. 9 Contains 322 pages, 627 illustrations. Electric railways—electric locomotives—car lighting—trolley car operation—miscellaneous applications—motion pictures—gas engine ignition—automobile self-starters and lighting systems, electric vehicles, etc.

No. 10 Contains 513 pages, 599 illustrations. Elevators—cranes—pumps—air compressors—electric heating—electric welding—soldering and brazing—industrial electrolysis—electro plating—electro-therapeutic—X-rays, etc.

Also a complete 126-page ready reference index of the complete library. This index has been planned to render easily accessible all the vast information contained in the 10 electrical guides. There are over 13,500 cross references. You find what you want to know instantly.

THEO. AUDEL & CO.
72 Fifth Ave.
New York, N. Y.

Please submit me for examination **Hawkins Electrical Guides (price $1 each).** Ship at once, prepaid, the 10 numbers. If satisfactory I agree to send you $1 within seven days and to further mail you $1 each month until paid.

Signature.....

Occupation.....

Employed by.....

Residence.....

Reference..... E. E. Sept.

You benefit by mentioning the "Electrical Experimenter" when writing to advertisers.

Be a Certificated Electrician!

L. L. COOKE,
Chief Engineer, Chicago
Engineering Works

A Real Position for *You*

The country needs thousands of trained **Certificated Electricians** to fill good positions—and at big pay. It's all a matter of knowing how, and I will teach you by my up-to-date, modern instruction. You can learn at home without interfering with your regular work, by my highly successful method of **Home Instruction** in **Practical Electricity.** Prepare NOW, and be ready in a few months to earn

$46 to $100 a Week

A Real Opportunity for *You*

Wishing is never going to make your dreams come true. You've got to **study**—to **learn.** A man is worth $2 or $3 a day from his neck down—and no more; but there is **no limit** to what he can be worth from his neck up.

A trained mind is what gets the big pay. It is this training that you need, and I can train you in a few months. Are you ambitious to make a real success—then write me—today.

FREE Electrical Outfit

To every student who answers this ad I am giving a Splendid Electrical Outfit of standard size Electrical Tools, Instruments, Materials, etc., **absolutely free.** I will also send you—free and fully prepaid—Proof Lessons to show you how easily you can be trained at home to enter this great profession, by means of my new, revised and original system of mail instruction.

Free Employment Service

I am continually receiving requests from employers to send them trained Electrical men. I assist my students to secure good positions. I keep in touch with them for years, helping and advising them in every possible way.

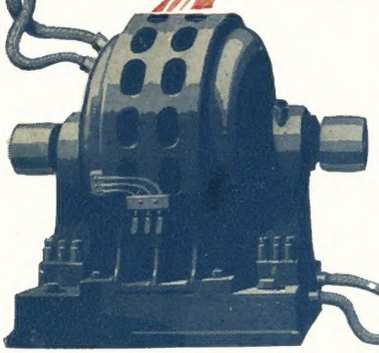
Send for This Book

My book, "HOW TO BECOME AN EXPERT ELECTRICIAN," has started thousands of young men on the way to splendid success. A new edition of this book has just been printed. I want every young man interested in Electricity to have a copy, and will send you one ABSOLUTELY FREE AND PREPAID. Write me today.

How I Train My Students

As Chief Engineer of the Chicago Engineering Works I know exactly the kind of training a man needs to enable him to get and hold good positions, and to earn big pay. I have trained hundreds of men who are holding splendid electrical positions. Many are now successful **Electrical Contractors.**

I give each of my students personal attention and a complete and thorough training. I give him a SPLENDID ELECTRICAL OUTFIT FREE, and much of the training is done by actual work. When my students graduate and receive their Certificate they are ready for a real position. But **still more,** at any time you wish you can come to our splendidly equipped **Electrical Shops** for special training. No other school can give you this.



WRITE NOW—DON'T DELAY

Delay never got you anything. Action is what counts. Get started—and get started now. Write me, right NOW.

L. L. COOKE,
Chief Engineer

CHICAGO ENGINEERING WORKS
Dept. 29—441 Cass Street **CHICAGO**

THE CAREY PRINTING CO. INC.
NEW YORK